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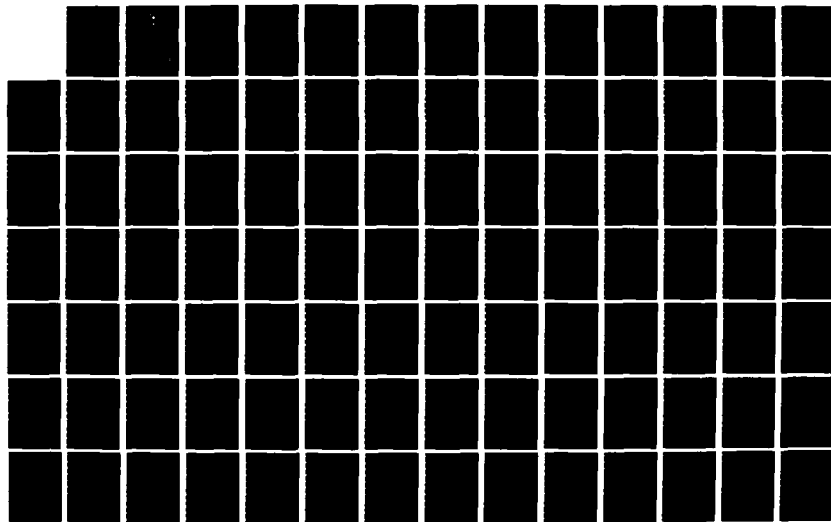
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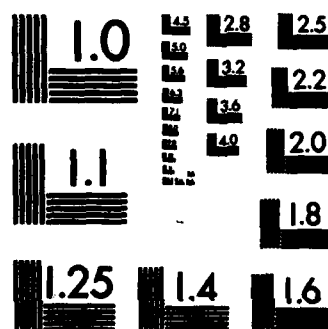
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LOGISTICS REQUIREMENTS FOR THE
SYSTEM SPECIFICATION

Odell A. Smith, Jr., Captain, USAF

LSSR 90-83

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Operating and Support (O&S) costs comprise more than half of a weapon system's total life cycle cost (LCC). In addition, 75-80 percent of a system's LCC is locked in by decisions made prior to definition of the detail system design. To reduce LCC, logistics alternatives must be addressed early and logistics constraints defined in the system specification. This thesis identifies the most likely sources of logistics constraint information so that it can better be incorporated into the system specification. This thesis addresses an alternate way to generate logistics requirements specifically for the system specification. It recognizes the Logistics Support Analysis (LSA) process and provides a way of focusing LSA inputs into the system specification. With this new procedure for early definition of the logistics requirements, O&S constraints are more likely to be adequately specified and their cost impact minimized.

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**AN IMPROVED METHOD FOR DETERMINING LOGISTICS
REQUIREMENTS FOR THE SYSTEM SPECIFICATION**

A Thesis

**Presented to the Faculty of the School of Systems and Logistics
of the Air Force Institute of Technology
Air University**

**In Partial Fulfillment of the Requirement for
Degree of Master of Science in Systems Management**

By

**Odell A. Smith, Jr., BSEE
Captain, USAF**

September 1983

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This thesis, written by

Captain Odell A. Smith, Jr.

has been accepted by the undersigned on behalf of the
Faculty of the School of Systems and Logistics in partial
fulfillment of the requirements for the degree of

MASTER OF SCIENCE IN SYSTEMS MANAGEMENT

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William A. Dea
COMMITTEE CHAIRMAN

Ronald A. Blackledge
READER

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I would like to thank my family. From my wife, Dorian, and my children, Courtney, Phillip, and Stephen, I received continuous support and understanding. It was so very important and necessary.

I would like to dedicate this thesis to my parents, Mr. and Mrs. Odell A. Smith, Sr., who have given me support and guidance throughout my life, and to my wife's parents, Colonel and Mrs. Ray C. Staley (USAF Retired), whose continued interest and support throughout my career has been a tremendous encouragement.

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CHAPTER I

INTRODUCTION

The acquisition of new weapon systems has always been and will always be extremely critical to the survival of the United States. In the last three decades, the technological complexity of weapon systems has grown at an exponential rate (26:112). Though this has provided improved capabilities for deterring and waging war, it has also been responsible for massive increases in weapons costs. The more familiar cost of acquiring new weapon systems has grown, but the most significant area of cost growth has been with operating and support costs (O&S).

The need to address total system life cycle cost (in lieu of acquisition cost only) is evident, and experience has indicated that logistics support constitutes a major contribution to life cycle cost...[3:51]

Operating and support costs have grown so rapidly that they now dominate as the major element in a system's total life cycle cost (24:5). "In fact, since 1967, operating and support costs for each hour we fly an aircraft have quadrupled [9:9]." With operating and support costs being such a major consumer of our limited resources, we must make every effort to ensure that we make the optimum decisions with regards to requirements that influence these costs.

The issue of defense requirements and their costs has always been important, but has become more prominent

recently. During the last two decades, a number of methods were proposed by and for the Department of Defense (DoD) as ways to hold down costs and still achieve the required performance goals. Some of the major efforts were the "fly-before-buy" concept, "should-cost" estimates, fixed-price contracts, and the use of life cycle costing (LCC) techniques. The fly-before-buy concept requires a contractor to develop and build an item that can be evaluated prior to any contractual production agreements. Should-cost estimates are done by a Government team of personnel at a contractor's plant, and the purpose is to develop a realistic price objective for negotiation purposes. Fixed-price contracts provide for a firm price or under certain circumstances an adjustable one. Life cycle costing requires that the total cost of an item over its full life (especially the O&S costs) be estimated and used in procurement decisions. Many areas of the systems acquisition process, and the environment in which it operates, have been subject to improvements for the purpose of reducing costs.

Integrating Logistics

For many years, the costs for weapon systems were erroneously considered to be only the procurement or purchase costs. These costs are in reality less than half of the total cost (LCC) of owning most major weapon systems. The largest portion of the LCC is the operating and support costs. O&S costs are the cost of operation, maintenance, and follow-on logistics support of the end item and its associated support systems (21:107). They include such items as maintenance, spares, facilities, etc.. The importance of the support area was realized about twenty years ago as a result of initial studies of life cycle costs. The increasing awareness of the significant contribution O&S costs made to total LCC made O&S costs a fruitful area for study, policy changes, and cost reduction benefits. The major concept which developed (4:59), with the purpose of improving the impact of O&S costs on total life cycle or system costs, was the concept of Integrated Logistics Support (ILS).

The ILS concept was formalized in 1964 by the Department of Defense. "This policy required that all of the services consider, estimate, and evaluate the life cycle costs associated with various design alternatives encountered during the weapons system acquisition process [5:2]". In other words, the design of the system should be determined in part by logistics considerations as well as by per-

formance and costs. Acceptable performance should be achieved along with the highest levels of maintainability, reliability, and supportability possible. The Air Force established its ILS policy with the publication of AFR 800-8, Integrated Logistics Support (ILS) Program, in July 1972. This was revised in February 1980 and provides detailed guidelines and responsibilities for achieving ILS throughout the life cycle of a system. AFR 800-8 defines ILS as a :

unified and iterative approach to the management and technical activities necessary to:

- (1) Cause support considerations to influence both requirements and design.
- (2) Define support requirements that are optimally related to the design and to each other.
- (3) Acquire the required support.
- (4) Provide for the required support in the operational phase at minimum cost.

Additional information on ILS and the major elements that comprise it is provided in Appendix D.

As ILS evolved and became more thoroughly defined, a number of processes were developed to aid in the integration of support elements with the system design. The most comprehensive of these processes, which assists in accomplishing the first three of the above objectives of ILS, is the Logistics Support Analysis (LSA). LSA has also recently been referred to as Weapon System and Equipment Support

Analysis (WSESA). LSA is the:

selected application of scientific and engineering efforts undertaken during the acquisition process...through the use of an iterative process of definition, synthesis, tradeoff, test, and evaluation. The objectives of support analysis are to:

- 1. Influence the system performance parameters and system configuration from a supportability standpoint.**
 - 2. Determine the support and manpower, personnel, and training(MP&T) requirements for the system which are optimally related to each other and to the design and operational characteristics of the system.**
- [21:111]**

The LSA process, and guidance on its application, are described in MIL-STD-1388-1A. LSA is a tailorable process that allows flexibility depending on the type, size, and complexity of the system being acquired and the particular phase of the acquisition process. It is normally accomplished by the contractor according to tasks spelled out by the Government. LSA is a very detailed process in which a data base of information on the logistics aspects of system design is progressively developed and maintained. This includes documentation of performance and logistics considerations and tradeoffs. Appendix A contains a description of the purpose of each LSA major task area and a listing of all LSA tasks and subtasks.

Many different logistics requirements, constraints, and objectives are taken as inputs to the LSA process. An iterative analysis process yields the specific outputs required by LSA for the particular phase of the acquisition

process. These outputs should provide the data needed to develop a comprehensive logistics support system. LSA is one process through which we hope to achieve the objectives of ILS. Most of the detailed LSA efforts, as described in MIL-STD-1388-1A, will be accomplished during the Full Scale Development (FSD) phase of the acquisition process, although preliminary LSA should be accomplished during the conceptual or demonstration/validation phase. The LSA effort that a contractor is required to perform is usually described in the Statement of Work (SOW) portion of the Government contract. This description is normally in the form of selected tasks out of MIL-STD-1388-1A which are tailored to the specific program. The tasks are essentially the analysis processes that the contractor is required to accomplish. The contract also contains a Contract Data Requirements List (CDRL). The CDRL lists and describes all data requirements for the contract and includes a description of any LSA output that will be required to be delivered to the Government.

Military Specifications and Standards

Specifications and Standards play an important role in the acquisition process. They are used to spell out requirements for the item being procured. There are over 40,000 specifications and standards listed in the Department of Defense Index of Specifications and Standards (DODISS). They serve to state requirements in a form that can be referred to by different Government buyers when procuring an

item with common requirements, so that a description of the requirement does not have to be generated on a recurring basis. Mr. John J. Riordan, former director of Product and Production Engineering, Office of the Secretary of Defense (Installations and Logistics) stated that:

Standards and specifications are essential to social, industrial, and technological progress, because they constitute the continuing technical record by which experience and invention (emphasis supplied) are transferred from one person to another, from one generation to the next. Were it not for these documents, it would be necessary for each of us to redefine and redescribe the products and services we manufacture, distribute, or acquire each time we enter the market place. Thus, standards and specifications serve a function much larger than standardization [14:6].

Program Peculiar Specifications

Another category of specifications are those which must be used when an item is procured for which a DODISS specification does not exist. These are usually new development type items, and the associated specifications are referred to as program peculiar specifications. The use of, and content/format requirements for, such specifications is described in MIL-STD-490. There are many types of program peculiar specifications including system specifications, development specifications, product specifications, process specifications, and material specifications. Program peculiar specifications primarily define items being used in a single system, and are not appropriate for listing in the DODISS. They do, however, reference DODISS specifications and standards in identifying requirements.

Use of the Specifications

Ironically, as important as adequate specifications are, their contribution to excessive costs came from their overuse. In the interest of achieving the "best" system for past military applications, excessive numbers of DODISS specifications were used which many times referenced other unnecessary specifications. In addition, program peculiar specifications included extensive referencing of untailored DODISS specifications, to ensure coverage of required areas. The result was both unnecessary costs and adverse effects on performance. "Both Congress and the General Accounting Office have condemned specifications and standards as sources of poor performance, goldplating, excessive delays, and unnecessary costs [6:10]." A U.S. Defense Audit Service report described the difficulties as follows:

The missapplication and insufficient tailoring of specifications and standards in defense acquisition programs sometimes has led to increased costs and delays in the introduction of new hardware. This can be attributed to past emphasis on achieving maximum performance without regard to cost, to the institutionalized attitude that specifications and standards were mandatory and had to be applied in their entirety (emphasis supplied), and to the lack of emphasis on the proper application and tailoring of documents to a specific need. [18:1]

Because of the difficulties with specifications, a movement surrounding the study of specifications and potential improvements in their use spread throughout the DoD and defense industries. One of the major initiatives which resulted from this movement was the application of the concept of tailoring of specifications.

Tailoring is the modification of existing contractual specifications and standards, where necessary, to assure that each modified document states only the minimum needs of the Government [18:1].

The importance of the concept was demonstrated when Deputy Secretary of Defense William P. Clements issued a Memorandum on 8 August 1975 which directed the military departments to:

Institute procedures and policies to control blanket contractual imposition of such specifications and standards. These controls should be structured to force technical activities to tailor requirements to the essential, specific, operational needs of the end item equipment or system [6:12].

A number of efforts were undertaken by the services to institute tailoring and ensure the selective application of specifications in the acquisition process. One effort made within the Air Force Systems Command (AFSC) was the development of a new specification-writing process for program peculiar specifications as an addition to MIL-STD-490 guidance. The process was initially worked on and used by the Aeronautical Systems Division (ASD) of AFSC to develop the specifications for new aeronautical weapon systems and subsystems. The new process, entitled Mil-Prime, was basi-

cally a new way of generating and tailoring the requirements language used in system specifications sent to contractors.

The Mil-Prime specification method focuses on operational needs in generating requirements. Specifically, a Mil-Prime specification document states the applicable operational needs, general parameters, and interface requirements for a given type of subsystem and its components. Specific values that will meet the mission needs are determined by the Government engineer and filled in for each parameter, requirement, or need. In determining these specific values, the engineer uses a Mil-Prime handbook which is correlated with the Mil-Prime specification. The handbook contains technical rationale for each requirement type and guidance for applying the specification. The handbooks also contain lessons learned in each requirement area. The draft system specification generated by this Mil-Prime process becomes a part of the Request for Proposal (RFP) or the contract issued to the contractor.

Logistics Requirements in MIL-STD-490

As discussed previously, the incorporation of ILS into the acquisition process and the system design is in large part dependent on the success of the LSA process. The LSA tasks are included as portions of the SOW, which is in turn part of the contract. The system specification for a new weapon system would also be part of the contract and would identify requirements of the system being acquired.

The system specification:

...states the technical and mission requirements for a system as an entity, allocates requirements to functional areas (emphasis supplied), and defines the interfaces between or among the functional areas. Normally, the initial version of a system specification is based on parameters developed during the concept formulation period or an exploratory preliminary design period of feasibility studies and analyses. [22:3]

Logistics is one of the functional areas specified by MIL-STD-490. Logistics requirements must be included in paragraph 3.5 of the system specification, as required by MIL-STD-490, including requirements for system Maintenance, Supply, and Facilities. The section of MIL-STD-490 relating to logistics is shown in Fig. 1. However, the description of the kinds of specific requirements that should be included under these areas is very general. How the specific wording of the requirements would be determined is unclear, and yet it is critical that the requirements be adequately and clearly defined.

**Excerpt from MIL-STD-490 Content Requirements
For A System Specification**

Paragraph 3.5: Logistics

Paragraph 3.5.1, Maintenance. This paragraph shall include consideration of factors such as: (a) use of multipurpose test equipment; (b) repair versus replacement criteria; (c) organizational levels of maintenance; (d) maintenance and repair cycles; and (e) accessibility.

Paragraph 3.5.2, Supply. This paragraph shall specify the impact of the system on the supply system and the influence of the supply system on system design and use. Considerations shall include: (a) introduction of new items into the supply system and re-supply methods, and (b) distribution and location of system stocks.

Paragraph 3.5.3, Facilities and facility equipment. This paragraph shall specify the impact of the system on existing facilities and facility equipment. It also shall specify requirements for new facilities or auxiliary equipment to support the system.

Fig. 1. Logistics Considerations from MIL-STD-490.

The system specification is usually initially prepared during the conceptual phase of the acquisition process. As noted earlier, decisions about the system requirements made prior to the start of Full Scale Development have been found to determine approximately 85 percent of the total system life cycle costs (9:9).

...a great deal of the impact on projected life cycle cost for a given system or product stems from decisions made during the early phases of product planning and conceptual design. Decisions at this point have a major effect on operations in all subsequent phases of the life cycle. As logistics costs may assume major proportions, it is essential that logistics support be considered at the early stages of system/product planning and design...
[3:51]

Therefore, the inputs to the system specification, especially the logistics requirements, have a major impact on total life cycle costs. And while it is true that requirements in the system specification may be refined and improved during the demonstration/validation phase and the Full Scale Development phase of the acquisition process, the first iteration of the system specification requirements has the most significant impact on the LCC. The complete set of data and analyses from the LSA process are not usually available until the acquisition process is well under way, often well into Full Scale Development. The LSA process can optimize the design only to the extent that flexibility is still available. Though LSA plays a critical role, it is even more

important that we identify logistics requirements well and place them in the system specification early to have the most significant impact on a system's total life cycle costs. But what sources are available for determining the logistics requirements?

Problem Statement

The importance of defining comprehensive requirements early in a program is significant.

Based on many surveys, there is a wealth of evidence that the most pervasive single, technical source of difficulties in system programs is a matter of deficiencies in the amount and quality of system engineering effort applied during early phases to develop, document, and verify adequate definitions of requirements. This deficiency has been recognized as being a chronic characteristic of system programs in general, for decades [15:69].

This is especially true about the definition of logistics requirements for the system and its component parts, "logistics considerations are often vague-even unrealistic. Logistics factors must be just as carefully identified and planned [13:16]." The system specification certainly has the potential for improving the identification of the logistics requirements.

Much study and analysis is accomplished concerning logistics topics. The Integrated Logistics Support program, including Logistics Support Analysis, requires that a number of analyses be conducted to determine what the logistics needs for a system will be, how design

decisions must be constrained to address support, effects of alternative support decisions, etc.. There are also some preliminary studies performed which determine certain logistics constraints and requirements. But even though we obtain "output" from such studies and analyses, we seldom translate them adequately into logistics requirements and needs for the hardware and software comprising the system. In a thesis concerning barriers to implementing Integrated Logistics Support for systems under development by ASD, Hull and Lockhart found the most significant barrier to be:

Inadequate definition of logistics design parameters and requirements in program directives, combined with the difficulty in translating those parameters which are identified into achievable, verifiable goals (emphasis supplied) for the contractor [10:70].

This thesis seeks to determine, for the logistics areas required to be addressed in paragraph 3.5 of a system specification, which constraints and requirements may be defined early in the acquisition process. The sources of data to define these requirements will also be a major research area. The availability of this information to the individual writing the system specification could have a tremendous impact on the success of ILS in the acquisition process, since the system specification allows a program office to contractually enforce the verification of the contractor's successful

attainment of the logistics requirements.

While LSA is usually a contracted effort, it is hypothesized that a form of LSA is accomplished by certain Government agencies during preliminary design studies and analyses. The resulting constraints and requirements relating to logistics, however, may not have a significant impact on the system design until the formal LSA process is conducted during Full Scale Development. This may be too late to achieve maximum benefits. Critical logistics requirements can be known early in the acquisition cycle, and sources can be identified from which they can be obtained. Such information might even be provided in the format established by the Mil-Prime effort, in that alternatives for the different requirements can be selected depending on the decisions made. With this information, greatly improved logistics requirements can be included in the system specification, and a significant impact on total system costs can be achieved.

Research Objectives

The first objective of this thesis is to identify, in light of the logistics considerations required by MIL-STD-490, the potential support requirements and constraints that could be defined during the very early stages of a system's life.

The second objective of this thesis is to identify the sources of information about specific program parameters defining the subject requirements and constraints. These sources should be provided to writers of a system specification early in the conceptual phase.

Research Questions

1. What specific types of logistics criteria must be available early in the acquisition process for a system (overall logistics concept, basing, depot support, etc.)?
2. What agencies or commands establish these early logistics requirements or constraints?
3. What documents or decision instruments (DCP's, PMD, etc.) contain these logistics requirements that have been established?

CHAPTER II

METHODOLOGY

Research Plan

In order to determine what logistics support requirements and constraints might be known at the early stages of a program, and where they might be obtained, an investigation was conducted among a population of logistics support experts who are also involved in the acquisition process. Potential logistics areas that would possibly have constraints known early were initially determined from evaluating the logistics requirements portion of MIL-STD-490. Two additional logistics areas relating to Computer Program Support were added to the MIL-STD-490 considerations. These two areas were recommended in a MITRE Corporation report to be added to the logistics section of MIL-STD-490 (15:100). The report was prepared for ESD and dealt with preparation of the system specification. The experts were interviewed and asked whether the identified logistics requirements could be known early, what the sources of the requirements would be, and where they could be obtained. They were also asked if there are other new types of requirements that should also be included in with the MIL-STD-490 ones. The specific interview questions used are

contained in Appendix B. The information obtained from the experts was used to determine if there exists some consensus on the types of logistics requirements that can be known early. More importantly, their inputs provided the sources of these requirements, including the agency or function that would establish them and the document in which they would be published.

Population and Sample

For this investigation, there existed a well defined population. In order to describe this population, it is necessary to address some organizational and functional relationships utilized for system acquisition. (Additional information about systems acquisition and the functions required to accomplish it is contained in Appendices C and D.) The Air Force Systems Command (AFSC) is responsible for the development and procurement of weapon systems to meet the required needs of the Air Force. AFSC is composed of a number of agencies including five major product divisions. One of the major product divisions is the Aeronautical Systems Division (ASD) at Wright-Patterson Air Force Base (WPAFB), Ohio. As the title implies, this division deals with systems characterized primarily by an aeronautical function (aircraft and air-breathing missiles). For the different programs conducted by ASD, system program offices (SPO's) exist for the purpose of program management. A program manager (PM) is in charge of the SPO and the SPO is the

single agency for managing the overall acquisition of the system.

Air Force Logistics Command (AFLC) is responsible for supporting systems once they are fielded and operational. In the effort to better integrate logistics considerations into the acquisition process, AFLC has established the Air Force Acquisition Logistics Division (AFALD) at WPAFB, OH. AFALD's mission is:

..to improve USAF force readiness and reduce life cycle costs by challenging requirements and assuring consideration of supportability, reliability, and maintainability during the design, development, and production process of weapons system acquisition, and to direct acquisition programs which use already developed systems to meet operational needs. (1:1-1)

AFALD's staff works closely with SPO's, using commands, and Air Logistics Centers (ALC's) to accomplish this mission.

One of the functions within a SPO is the Integrated Logistics Support Office (ILSO). The manager of this office is either an Integrated Logistics Support Manager (ILSM) or a Deputy Program Manager for Logistics (DPML), depending on the size of the specific program. Personnel who fill such positions are assigned from AFLC (for reporting purposes, they normally fall under AFALD), but functionally they work for the PM. They are responsible for determining and refining ILS requirements for the system being acquired.

The target population for this investigation consisted of two distinct groups. Both groups were selected for the research because their job responsibilities require

them to work logistics issues in the acquisition of weapons systems. The first group is the logistics personnel assigned to the ILSO's in ASD who work with ILS and/or LSA. These logistics personnel may be the DPML or subordinate to him/her. This group is considered appropriate for the research as they are the ones most likely to possess expertise in ILS and to know how the LSA process is used to ensure that ILS is accomplished. They are also in the key position of having experience in integrating the logistics and acquisition efforts. They are expected to have varied experiences in the acquisition process and different levels of expertise with LSA. Only logistics personnel assigned to ASD SPO's were considered for the first group of the target population. This limitation was required due to the researcher's time and resource constraints. The results of the research will be generally applicable to those programs procuring aeronautical weapon systems. The applicability of the research to programs for other types of systems will have to be validated through further studies.

The objective in the selection of sample members from the SPO's was to obtain data from personnel in a broad range of program types, sizes, and phase completions. The aim was not to obtain a critical number of personnel in order to have a statistical sample, but rather to use a purposive sampling procedure to obtain the broadest representative sample possible. By determining the programs currently

being conducted by ASD, specific programs for accomplishing the above sample objective were selected. The programs chosen were purposely selected to include a large program (B-1B), some small programs, such as the LANTIRN and the Standard Central Air Data Computer (SCADC), as well as programs that were in different phases of the acquisition process. From each program selected, qualified LSA personnel were identified as potential sample members. The selection of personnel from each program office was done by calling the offices and making contact with the individual chiefly responsible for LSA. These logistics experts were the first sample group.

The second group in the population are members of the AFALD staff who are the core of the Air Force expertise in LSA and many other ILS efforts (AFALD/PTA). These personnel are responsible for policy and application guidance of LSA in the Air Force. They aid both the DPML's and the ALC's in ensuring that ILS is accomplished. This group was selected for the research because of their extensive expertise with LSA and ILS, because of their ability to look at LSA with a staff level or policy perspective, and because they could serve as a control group against which to compare the first group's data. The control for the research would be accomplished by checking the results to verify that findings obtained were supported by both groups. It is conceivable that the SPO group personnel could all agree on a cer-

tain area, due to having a limited "program" perspective. The group from PTA, with their broader perspective, could provide a different but more accurate answer. The group responses will be checked for any such discrepancies, and if they exist they will be addressed in the analysis.

The AFALD/PTA office (Directorate of Engineering, Logistics Support Analysis Division) is the OPR for LSA. In selecting the sample members from this group in the population, again a purposive sampling procedure was used. By interviewing several members of the AFALD/PTA office, the researcher was able to obtain a consensus on who were the most experienced personnel in the office. There are currently eleven personnel assigned to AFALD/PTA. The three most experienced personnel, including the division chief, were selected for the research as the second sample group. These three personnel possess the major portion of AFALD's expertise in LSA, and qualify as a representative sample.

Data Collection Plan

In order to obtain the required data from the sample members, a structured interview approach was selected (see Appendix B). The interview consisted of a list of standardized questions asked of each sample member and a few open-ended questions at the end of the interview for additional comments. The open-ended questions were designed to yield additional logistics areas for which requirements may be

identified early. The structured interview approach was selected vice a questionnaire approach, as it was expected to provide unambiguous communication on the subject from both the researcher's and the subject's points of view. The structured interview was necessary to insure standardization of the research process across the range of samples, and to minimize the impact of any situational factors (disruptions, personality conflicts, etc.) which might confound the results.

The interviews began with a brief explanation of the purpose of the study, and an explanation as to why the interviewee was selected. The remainder of the structured portion of the interview contained questions. There were several demographic questions to establish the experience, expertise, and job position of the subject. These questions were addressed first as they were easy to answer and were hoped to put the subject at ease. The specific questions addressing logistics requirements, that have been identified through research of MIL-STD-490 and various LSA documents, were addressed next. The questions asked about the agency or command that would develop a logistics requirement, and the document or product that the requirement would be published in. A section of the questions also asked if these identified areas correlated with specific LSA output areas. The last questions were open-ended and allowed the subjects to identify logistics requirements that might be available

early in the acquisition process, and that the subject was aware of from his/her own experience.

The questions addressing the specific logistics areas chosen, and the open-ended questions, were intended to answer research question one concerning the types of logistics areas that might have requirements identified early in the process. The questions addressing which agencies or commands would establish these requirements were to answer research question two. The questions addressing the documents or decision instruments which should contain these logistics requirements were to answer research question three.

The interview approach was first tested by having it reviewed by a member of the Air Force Institute of Technology School of Systems and Logistics (AFIT/LS) faculty and by a senior member of the AFALD/PT staff (25). This test was primarily to determine clarity of the questions, adequacy of the question in acquiring the desired data, and an estimate of the time required to conduct the interview. Revision of the questions was required to improve their clarity and to make them more specific so that the data eventually obtained could be analyzed. The AFALD staff member did address a separate concern about the questions which is discussed in Chapter 3.

The subjects were initially contacted by telephone or in person and a suitable time for the interviews

arranged. The subjects were informed of the general subject area of the interview and given an estimated amount of time that would be required. The interviews from the two groups were to be intermixed to prevent any learning curve impacts on the researcher from significantly affecting one samples data.

Data Analysis Plan

The purpose of the research is to determine the types of logistics considerations that can be known early and the sources of this information. An attempt is being made to gain additional information relating these items to eventual LSA output. The above information will be gained from the interviews. The questions used for the interviews addressed each of the logistics considerations required by MIL-STD-490 to be included in paragraph 3.5 of a system specification. They also addressed the two computer program support areas. After all responses have been collected, the analysis will be performed to answer each research question.

To answer research question one a review of all responses, by logistics consideration, will be conducted. This review will objectively determine, from all comments on each logistics consideration, whether each particular consideration is a requirement area that must be addressed early in the life cycle. For each logistics consideration, at least half of the subjects need to indicate that it needs to be addressed as an early requirement before it will be

accepted. The open-ended question also provides the opportunity for sample members to add other logistics considerations that should be addressed early. Responses to this question will be evaluated by looking for two subjects to agree on the same recommended additional logistics consideration. If several areas are recommended, but without any duplications to provide the needed support, the results will be provided but the areas will not be considered as vital early logistics requirements areas.

To answer research questions two and three, the responses will first be grouped for each interview question. For example, interview questions 8-18 each contain multiple parts. All responses to 8a. will be grouped, then 8b., then 8c., then 9a., etc.. Research question two addresses identifying the sources of logistics requirements. Interview question 8a. asks for the best source of early requirements relating to multipurpose test equipment. All sources provided in the answers to question 8a. will be considered as valid ones, however, the "best" source will be the one receiving the most responses under that question. If two different sources receive equal support, they will both be considered as "best" sources on multipurpose test equipment. A check will be made to ensure that results found are supported by some members of both groups. This same analysis procedure will be conducted for each part (a) of questions 8-18.

To answer research question three, a similar procedure will be followed to that described above. For parts (b) of questions 8-18, the responses will be grouped for each question. For the logistics consideration that a particular question (8b., 9b., etc.) addresses, the "best" document for early requirements on that consideration will be the one receiving the most responses. Again, if two responses tie for the qualification, they will both be accepted as valid.

The responses pertaining to LSA related output areas will receive a similar analysis. As noted earlier, there will be responses from essentially two sample groups. If there are major discrepancies between the two groups, such as no agreement on certain areas, they will be investigated. The "best" answers for the various logistics considerations will provide the sources of early logistics requirements or constraints (those selected for the research) and the documents that they would be published in. The agencies that identify these requirements, and the documents that they are published in, will be considered vital sources of information for those individuals preparing logistics requirements for the system specification.

CHAPTER III
RESEARCH RESULTS
General

As described in Chapter 2, the research was to be conducted among two groups of personnel, both working with the logistics aspects of the acquisition process. These two groups were the AFALD/PTA staff and the population of LSA contacts working in the ASD SPO's. The PTA office is responsible for monitoring all Air Force efforts with LSA, for establishing policy and guidance on the application of LSA, and for aiding most program offices in writing the LSA portions of Statements of Work. As planned, the research interview questions were first reviewed by an AFIT/LS faculty member and a senior AFALD/PTA staff member. The questions were revised as needed to achieve clarity and conciseness. After reviewing the questions, the AFALD staff member suggested that the questions assumed an extensive background and much experience with the acquisition process. Concern was expressed that the experience of most LSA personnel working in the SPO's would not necessarily include involvement with a major program at its inception. Many of them therefore, would not be familiar with what command or agency actually established requirements for the logistics issues that the questions addressed.

The LSA specialist's efforts begin during the conceptual phase, but are primarily concentrated on the Full Scale Development phase. The primary duties of the LSA specialist, with respect to LSA responsibilities, are to ensure that the SOW is written with the appropriate tasks from MIL-STD-1388-1A specified. This is not simply the selection of tasks that appear necessary; it is essentially an analysis process in itself. The tasks specified must be appropriate for the type of program, for the program phase, and for any peculiarities of the weapon system being acquired. A similar process must be performed in specifying the data requirements that should be included in the CDRL for the various LSA output categories. Once the LSA process has been initiated in this manner, the LSA specialist must then monitor the contractor's efforts. Accomplishment of these responsibilities is very much a part of integrating logistics considerations into the system design.

It was, however, the aim of the research to obtain information from those familiar with the logistics analyses, decisions, and requirements developed very early in the life of a program. Personnel were required who would be familiar with whether the MIL-STD-490 considerations were addressed, who addressed them, and in what document. In light of the justifiable concern expressed by the AFALD staff member, and the incorrect assumption on the researcher's part that all

LSA personnel would be omniscient in the area of acquisition logistics, it was decided to re-evaluate the target population to be sampled. The purpose of this re-evaluation was to determine if the population selected, or some other one, would be the best source of information for the research. Information could be obtained from the originally planned subjects, and it would be good information. However, it seemed more profitable to find the population that was best for the research, and therefore would provide the best information.

The group of personnel to be interviewed from AFALD/PTA remained valid sample members. Their work with acquisition logistics issues on many programs and at all phases made them still excellent sources. The strategy for selecting other personnel with the required experience actually evolved instead of being immediately developed.

Sampling Problems

The first step that was taken was to conduct the structured interview with a few LSA personnel working in the SPO's. This was done to get an indication of the type of answers that would be obtainable from LSA personnel, and more basically, to determine how well they would be able to answer the questions. Because the Air Force did not emphasize LSA until recently, it was discovered that only the newer programs would have LSA personnel who had worked

LSA early in a program. Older programs (4 or more years) would have LSA personnel assigned, and LSA on contract, but they would have begun LSA in the middle of the program's life cycle. In spite of this, those LSA personnel interviewed were able to answer many of the questions from their experience. Even so, it did seem reasonable that a better group of personnel should exist with experience and background more appropriate for the questions being asked.

It was next decided to interview personnel who were responsible for ILS in the SPO's instead of only the LSA area. Since ILS personnel would be exposed to logistics issues at the highest level of the program office organization, they were considered a better source of information. This effort was begun with interviews with two personnel in the ILS office of the B-1B. Because of their experience with the early phases of the B-1B and work with other programs, both individuals were able to answer the questions well. One of the interviewees suggested that personnel working in the AFALD/XRS office would be even more qualified to contribute to the research. The AFALD/XRS office works with programs during concept formulation, and both conducts and evaluates analyses. They also have an input to the requirements that are established for new programs. This suggestion from the interviewee was a valid one. After considering this suggestion, a new approach for determining the remainder of the sample members was developed.

New Sample Plan

It became apparent that the best sources of information on logistics requirements that would be developed early in a program's life would be those offices that were actually involved with programs at their earliest stages and concerned with logistics issues. These primarily are the staff agencies of Headquarters Air Force, the using commands, the procuring command (AFSC), and the supporting command (AFLC).

Advice was sought from AFIT/LS faculty members on which offices within the above commands would be best for the research. The researcher was referred to AFLCP/AFSCP 800-34, Acquisition Logistics Management. This pamphlet is a basic reference book for acquisition logistics matters and provides an overview of the various functions and required interfaces of acquisition logistics management. The portion that was extremely beneficial, was a matrix of logistics functional areas correlated with organizational contacts at many of the commands and organizations involved with acquisition logistics management [2:A1-1].

The functional areas of Integrated Logistics Support Plan, Logistics Support Analysis, Facilities, and Computer Resources in AFLC/AFSCP 800-34 were chosen as the ones that would have personnel most knowledgeable in the areas of interest. Using these four functional areas, offices were

selected to be contacted that were responsible for these areas within the AFALD and ASD organizations. AFALD was chosen as it is the acquisition logistics agency for AFLC, and ASD because it is the AFSC product division that has the largest number of major programs. The added convenience of their proximity to the researcher was also a factor.

Once the offices were selected, they were contacted and an interview scheduled with either the chief of the division/branch, or with an experienced individual. It should be noted that offices working with ILSP and LSA would have broad experience relating to all of the questions in the interview, whereas the Computer Resources and Facilities offices would only be expected to have expertise in their specialty areas.

There was one other excellent idea received by the researcher on additional sources to those selected above. This idea was to contact the staffs of using commands and interview personnel working with logistics issues on programs still in the conceptual phase. One of the newer aircraft programs is the Advanced Tactical Fighter (ATF) program being conducted by ASD for Tactical Air Command (TAC). To get a using command input, contact was made with the office at HQ TAC/DR that was responsible for developing the requirements for the ATF, including logistics. One of the very experienced personnel in that office was interviewed.

The number of personnel composing the total sample was fifteen. The fifteen people can be grouped into three different categories. The first category is LSA and ILS personnel from SPO's who are working with current programs. There were five personnel in this category. The second category is the personnel from the AFALD/PTA office. These remained the same as in the original plan and the number remained at three. The third category was made up of personnel who worked in headquarters staff offices. These personnel were more involved in programs at the conceptual and mission analysis stages. This category consisted of seven personnel. The three groups composing the sample represent three different levels of logistics management personnel working in the systems acquisition business. One group, the third category, is at the upper management levels, involved with new programs at their conception. The SPO group, the first category, can be considered as the line elements in the acquisition process. Their jobs require management of specific programs through the sequential phases of the acquisition cycle. The AFALD/PTA group, are essentially an interface between the other two groups, and responsible for seeing the concepts established by the staff levels implemented successfully by the SPO personnel. Having a representation from all three of these management levels in the acquisition logistics community provided a control against biased results. The control would be achieved by

checking all findings to verify that results were supported by at least one member of all three groups. Table 1 shows the sample composition by categories.

Table 1
Sample Composition

Category Type	Function	No. of Personnel in Sample
HQ Staff/User	Conceptual Analysis	7
AFALD/PTA	LSA Guidance and Application	3
Program Office Personnel	Program Management	5

Each subject was personally interviewed using the questions in Appendix B. The HQ TAC contact was interviewed telephonically. In conducting the interviews, the Facilities and Computer Resources personnel were only asked the questions relating to their area of expertise.

Research Question One

The responses from the subjects were analyzed in light of the research objectives and research questions. The first research question, which was developed to achieve the first research objective, asks:

1. What specific type of logistics criteria must be

available early in the acquisition process for a system? Although this question was essentially answered by the decision to use the logistics considerations required by MIL-STD-490, some analysis from the responses is possible. In addition to the MIL-STD-490 considerations, the two areas of Computer Program Support were added. These two areas were taken from a study done by the MITRE Corporation for ESD (15:100). Both areas were recommended as additions to the MIL-STD-490 paragraph on logistics. They were included in the interview questions in light of the tremendous growth in computer hardware and software applications in every subsystem arena of weapon systems. The appropriateness of the inclusion of these two areas in the research is an element of research question one. The open-ended interview questions allowed the subjects to suggest other areas for potential inclusion under MIL-STD-490 guidance, and their responses will be discussed. The most important analysis that was done under the auspices of research question one, was an evaluation of the subjects' comments on each interview question to determine if the considerations covered by MIL-STD-490 were valid ones to address in the system specification.

Research Questions Two and Three

The second and third research questions were stated as follows:

2. What agencies or commands establish these early logistics requirements or constraints?

3. What documents or decision instruments (DCP's, PMD, etc.) contain these logistics requirements that have been established?

These two questions both support the second research objective of identifying the sources of requirements or constraints for the logistics considerations addressed. These also encompass the issue that is the main thrust of this thesis, namely that we must address certain critical logistics issues during the early stages of the acquisition process and initial decisions on these issues must be made. Data for analysis to support research question two came from the responses to part (a) of interview questions 8-18. Data for analysis under research question three came from the responses to part (b) of interview questions 8-18.

As mentioned earlier, the output data from the LSA usually is not available until well into the FSD phase. When available, it can be used to corroborate or to revise system requirements. So, there was one last area of analysis accomplished that did not directly support the stated research objectives. This was an analysis of the responses to the interview questions that asked for the LSA output area that would relate to each consideration. The LSA task areas are all shown in Appendix A. Because of the backgrounds of the subjects interviewed, only the AFALD/PTA personnel were qualified to answer these questions. They are the experts in the LSA area and their answers are the

best data available.

All of these different analysis areas (who sets the requirement, where is it published, is it valid in the system specification, and LSA related output) will be addressed for each logistics consideration. The MIL-STD-490 considerations are addressed first followed by the two Computer Program Support considerations. In the next chapter, the analyses results from all part (a) interview question responses are grouped together to answer research question two. Also, the analyses results from all part (b) interview question responses are grouped together to answer research question three.

Analysis and Findings

Discussion of the Logistics Considerations

1. The Use of Multipurpose Test Equipment

In analyzing the responses from all of the subjects, there was a consensus in reply to this question. Almost every subject indicated that the using command would initially identify a requirement or constraint relating to multipurpose test equipment. Any such constraints would more than likely not be hard and fast. They would instead be a desired goal for this area that would not be expected to be changed a great deal. A tradeoff process, with this initial requirement being a major input, would ultimately lead to a joint decision among the using command, the appropriate Air Logistics Center (ALC), and either the associated product division or the SPO. During FSD, additional tradeoff studies would be conducted in this area by the contractor, if they were appropriate. A number of the subjects indicated that the MATE (Modular Automatic Test Equipment) program would have a significant impact in this area. Under the MATE program, standardization of automatic test equipment is an issue that is required by the SOW to be addressed by the contractor.

An analysis of the responses concerning where requirements on multipurpose test equipment would be published yielded three possible sources. This is explained by

the fact that there are several points in this iterative decision-making process that a firm decision could be reached. The three potential sources were the SOW, the System Operational Concept (SOC), and the RFP. The one document that was supported by most of the subjects was the SOC and particularly the Maintenance Concept portion of the SOC. The SOC is prepared by the operating command in conjunction with the procuring and supporting commands. It is prepared prior to or during the conceptual phase and addresses specific system topics. A preliminary SOC is normally formed following approval of the Statement of Need (SON). For this reason, it is reasonable that the SOC would be supported by most of the subjects in that, by the time the SOC is formed, some interaction between the using command, AFSC, and AFLC has occurred, and the decision would be a joint one. The SOC would therefore be the most likely source of early multipurpose test equipment requirements.

In evaluating all of the subjects responses, this logistics consideration does warrant continued attention and inclusion as now required by MIL-STD-490. It can be addressed early, and a decision or lack of one in this area will have long-range cost impacts. Some of the general requirements statements that have been used to address this area are:

Common/standard support equipment shall be utilized to the maximum extent possible.

There shall be no new support equipment developed.

Support equipment shall be compatible with standard connectors and power sources.

It is obvious that these are necessary when applicable, but definitely not sufficient. They do not really address multipurpose test equipment directly. One of the subjects pointed out that we have had a proliferation of support equipment because we have not forced the standardization issue as required by MIL-HDBK-300. This is a sensitive area for the contractors. They are able to recover additional costs that they had not included in the system costs in order to offer a competitive bid. Much improvement is possible in this area.

The question asking which LSA tasks related to this area received responses that revealed five related LSA task areas. The primary related task was 202, Mission Hardware, Software, and Support System Standardization. Results from Task 303, Evaluation of Alternatives and Trade-off Analysis, would also relate directly to this consideration.

2. Repair versus Replacement Criteria

3. Organizational Levels of Maintenance

These two maintenance considerations will be discussed together. Every subject indicated that these two areas are interrelated and are essentially determined

together. The responses were identical for both areas.

In analyzing the responses concerning what command would establish requirements for these two areas, there again is an iterative process that occurs prior to a final decision being made. The using command will normally identify a requirement in the SON, and it will be restated in the Maintenance Concept portion of the SOC. This requirement will be stated as a system objective and will be based on operational considerations and concepts. Following this user input, the SPO and the ALC will also address the requirement. The ALC will address the requirement from the depot support perspective. If the operational considerations are not binding constraints for the system specification, both the SPO and ALC will require Repair Level Analysis (RLA) as part of the LSA process required in the SOW. RLA is conducted based primarily on economic parameters. RLA would be required for each subsystem and its Line Replaceable Units (LRU). It is possible for decisions relating to levels of maintenance and repair/replace criteria to change several times, for individual components/assemblies of the system, as the design evolves based on the analysis results. It is difficult to establish very early a hard requirement for this area because the evaluation of alternatives is necessary. It is possible, however, to have more emphasis placed on certain constraints due to mission requirements. This will narrow down the

decision alternatives.

In analyzing the responses concerning the type of document that this requirement area would be addressed in, there was general agreement. The SON would be the first document to address this followed by the Maintenance Concept in the SOC. Beyond this, the issue would be addressed in the RFP, not as a specification requirement, but primarily to require analyses. The only early hard requirements would come from the user in the SON or SOC.

This logistics area must definitely be addressed in the system specification as currently required by MIL-STD-490. For those situations where operational considerations dictate decisions in this area, we must have the instrument for impacting the design with these early decisions. This instrument is the system specification. If the user does not establish a hard constraint early for this area, it still needs to be addressed and evaluated. If we do not have a firm requirement for the system specification, we should at least include the issue and state that the requirement is To Be Determined (TBD). We should also include a requirement for the analysis that we want performed in order for the optimum decision to eventually be made.

These two maintenance areas were found to be related to the LSA task areas of 201, Use Study; 303, Evaluation of Alternatives and Tradeoff Analysis; and 401, Task Analysis.

All LSA outputs for these areas would be based on RLA.

4. Maintenance and Repair Cycles

In analyzing the responses concerning who would establish requirements for this consideration, there was general agreement among the subjects. What the data revealed was that the user would potentially establish firm constraints for the system. These would be requirements in terms of turn-around times, mean down times, scheduled maintenance, and unscheduled maintenance. The user would most likely base these requirements on experience with existing systems and desired future operational considerations. There is also a potential for the ALC concerned to establish a requirement on the depot cycle times. As the design evolves, there will be some LSA analysis done concerning maintenance and repair cycles. The initial requirements will be major inputs to the analysis processes. This will primarily be at the subsystem level, but the results will have an impact on the system characteristics. The types of LSA analysis required in support of this area include Failure Modes, Effects, and Criticality Analysis (FMECA), Reliability Centered Maintenance (RCM), Preventive Maintenance Analysis, and Maintenance Task Analysis. However, these would all be performed by the contractor during Full Scale Development. So the only early sources of firm requirements in this area would be the user and secondly the ALC.

The requirements that the user would establish relating to maintenance and repair cycles would be found in the Maintenance Concept portion of the SOC. This would also contain any input from the ALC on depot cycles. The SOC is our best source of requirements in this area and should be the prime document used for forming related system specification requirements. The requirements for the various analyses on subsystems will be addressed under LSA in the SOW. These analyses are essential and may force the revision of some early decisions made at the system level. A couple of sample requirements statements are:

There shall be no scheduled maintenance.

Scheduled maintenance shall not be required at intervals less than _____ days.

No preventive maintenance task shall exceed _____ minutes duration at the organizational level.

This area is also one that appears well justified in being a MIL-STD-490 requirement. It cannot be overlooked in the system specification if there are indeed valid user and/or depot constraints. If cases exist where we do not have constraints established in this manner, we should definitely require system level analyses in order to know the cycle times that we would expect when the system becomes operational. This type of requirement could be written in the system specification in addition to its statement in the SOW.

The LSA task area that was shown to be the one relating most directly to this consideration was Task 401, Task Analysis. Under this task the requirements exist to determine repair/maintenance frequency and the time required.

5. Accessibility

Analysis of the responses from this area again reflected general agreement. The subjects indicated that the user would be the most likely function to establish requirements relating to accessibility. Accessibility requirements would in most cases be related to the maintenance and repair times already addressed, and might be driven by them. Aside from any accessibility requirements established initially by the user, almost every subject stressed that accessibility would be an issue that is continually addressed by the system engineering effort. This would occur primarily during Full Scale Development and would be the responsibility of the program office. One subject discussed the fact that accessibility needs to be addressed early, but it is not always practical to establish firm constraints.

In evaluating the responses concerning where accessibility requirements could be found, the most likely document would be the SOC. Several subjects indicated that this

type of requirement might first be written in the SOW where it would basically require accessibility to be considered in design decisions. This would essentially be an input to the design process and would not be a firm requirement. This is not the ideal place to put any firm requirements, which should be included in the system specification. Some of the types of accessibility requirements used are:

For maintenance purposes, LRU's shall be easily accessible.

To replace a failed item, the item should be accessible in X minutes.

For flightline maintenance activities required on the aircraft engines and avionics, access shall be possible without the use of maintenance stands.

Accessibility can also show up in other forms, which usually relate to the area of maintainability. An example is the use of fasteners on a panel. It would be expected that a single panel would have standard fasteners that are identical, so that in removing and replacing the panel a maintenance person would not be concerned with identifying and sorting the fasteners. There are existing systems where such panels have fasteners that are identical except for their length. The lengths for the fasteners on this particular panel can be one of six sizes. It takes little imagination to conceive of the difficulty this could cause a maintenance person under ideal environmental conditions, much less under conditions of severe weather or hostile fire.

Exterior panel fasteners on the aircraft shall be standardized, limited in their types, and easily removed and replaced.

The accessibility consideration does appear valid as a requirement under MIL-STD-490. It cannot be overlooked as an early consideration in the design. It does relate almost directly to maintenance and repair times and could feasibly be a sub-requirement to them. Accessibility is also addressed in required paragraphs relating to human factors/human engineering elsewhere in the system specification.

The only LSA output area that directly relates to accessibility is a block on the B-record. The B-record is a data output sheet on item reliability and maintainability characteristics.

6. Introduction of New Items into the Supply System and Re-supply Methods.

Responses concerning this area indicated that new items are limited as much as possible to utilizing existing systems of supply, transport, packaging, etc. by existing procedures established in military standards and regulations. This limiting is done within the systems engineering effort under the parts control and standardization programs and other similar processes. The major references governing this area are: MIL-STD-965, Parts Control Program; MIL-STD-

1561, Provisioning Procedures; AFR 57-6, DoD High Dollar Spare Parts Breakout Program; AFR 67-47, Phased Provisioning; AFR 800-24, Parts Control Program (PCP); and AFLCR 65-5, Air Force Provisioning Policies and Procedures. Other impacts that the weapon system might have on the supply system in the area of re-supply methods would potentially be stated in early requirements. Requirements for this area would come from both the user and the ALC. Re-supply methods are also dependent on the operational environment and such issues as transportability and storage constraints. This consideration will have more importance if the system is wholly or partially based overseas. Re-supply methods will be addressed in failure/re-supply tradeoffs using initial constraints as major factors. The initial constraints may be revised, though not radically. This area is also one where the maintenance characteristics discussed earlier, such as repair levels, will have a large impact.

The responses concerning where such requirements would be documented were generally poor. Very few of the subjects felt that any document would contain this type of requirement. This is reasonable if the subjects answered the question more in response to the portion of the question concerning new supply items, where a number of existing processes and documents provide some control. For those few subjects who did indicate a particular document in their response, the SOC was the document mentioned. The SOC would

be the primary source for requirements under this area. In retrospect, this question would probably have been better if it had been in two parts; one for the requirements relating to new supply items, and one to requirements relating to re-supply methods.

It appears that the issue of limiting new supply items is adequately addressed by procedures within the system engineering effort. This consideration should continue to be addressed under the logistics section of the system specification. The requirement should include a reference to DODISS documents that govern this area. Having this in the system specification will improve the contractual leverage in ensuring that the requirement is met. Any constraints relating to re-supply methods should continue to be addressed as required by MIL-STD-490. These types of constraints can have a significant impact on supportability, but the data indicates that they are not addressed sufficiently well or early. The requirements language used in the system specification will probably be essentially the same for all new programs, but it is necessary to establish this constraint on the contractor's design.

The responses on the LSA related output area revealed that Task 402, Early Fielding Analysis, would most directly support this consideration. Both parts of the question would be directly related to the analysis required by Task 402.

7. Distribution and Location of System Stocks

Responses for this area addressed primarily the location of system stocks and indicated that related requirements would be generated by both the user and the ALC. These requirements would not be firm but would be guidelines for such areas as War Readiness Spares Kits (WRSK), Initial Spares Support Lists (ISSL), and other spares kits requirements. The ALC would be the most dominant in establishing these types of requirements. These initial requirements would provide primary inputs to various LSA analyses that would use cost as a major criterion in final decisions on locating system stocks. Distribution methods were indicated by all subjects to be an area where new requirements would seldom be generated. This is due to the extensive existing distribution system which supports operational systems. However, in light of our extensive existing systems, requirements should be stated which constrain the design to the use of existing systems.

The only document that would provide requirements for this area would be the SOC. The SOC requirements would later be addressed by the SOW tasks. The SOW would require the appropriate analyses to be performed using these initial requirements. From the analysis results the final decisions for individual components/assemblies could eventually be made.

This area is valid as a MIL-STD-490 consideration. For many systems, it will be an important area and will have to be addressed. For a few systems containing oversized/delicate/hazardous components, such constraints will be critical.

The LSA task that most directly relates to this area is Task 202, Mission Hardware, Software, and Support System Standardization.

8. Facilities--Use of Existing Facilities.

9. Facilities--New Facilities Requirements.

These two areas will be addressed together as their responses were very interrelated. The general consensus from the subjects was that the facilities area has little to no impact on the system design. If requirements are generated early they would be by the user and the ALC. The user would address requirements for the system to be compatible with existing facilities such as hangars, aircraft revetments, power requirements, etc. and possibly go so far as to require a particular organization to be able to maintain the system with its organic facilities. The ALC would address the need for compatibility with existing depot facilities.

Most subjects described our primary approach to facilities as one where we task the contractor to tell us

what facilities will be required to support the system. This tasking is part of the SOW. The contractor must put this information in the Facilities Requirements Plan (FRP) which must contain the minimum essential facility requirements to support the system. In addition to this plan, we also buy facilities data, consulting services, aid with site surveys, and aid with final facility acceptance inspections. Facilities requirements addressed in the SOW must include consideration of test bases, operational bases, depot bases and training bases.

For requirements that are established for facilities, they would most likely be available in the SOC. The Maintenance Concept portion of the SOC would provide these.

The facilities area should continue to address the use of existing facilities. Even though existing facilities do not normally have a significant impact on the system design, the need to force an impact when necessary does exist. The more critical area is the determination of requirements for new facilities. The SOW will task the contractor to identify new facilities requirements as part of the Facilities Requirements Plan. A requirement for this type of contractor effort could also be placed in the system specification. It is critical that new requirements be identified as early as possible due to the time required (usually 5 years) for facilities to actually be constructed

under the Military Construction Program (MCP).

The LSA output area related to facilities is the F-record data sheet. This is the Facility Description and Justification record. The FRP is actually a more thorough document on this area, but it is not technically an LSA output.

10. Computer Program Support--Support Functions to be Provided at Operating Site(s).

An analysis of responses for this area showed that using commands would be the primary source of requirements for support functions to be provided at operating site(s). The ALC would also provide some inputs but would primarily review/modify/iterate the user's requirements. Some of the types of requirements would include the ability to replace/update/reprogram command and control software, threat programs, and mission programs. Others would possibly address requirements relating to support functions such as language requirements, comments in the programs, types of memories, and BIT requirements.

Two of the subjects were computer support experts and stated that our ability to establish requirements depends on the general mission category that the computer program will support. The five major categories are: Automatic Test Equipment (ATE), Communications-Electronics,

Electronic Warfare, Operational Flight Programs (Avionics), and Aircrew Training Devices. For a major weapon system, each of these categories may have different requirements and they should all be addressed. Early requirements that can be firmly established will be critical inputs for use by the Computer Resources Working Group (CRWG) function in the SPO. They will also be major inputs to the Computer Resources Integrated Support Plan (CRISP) produced by the working group as required by AFR 800-8 and AFR 800-14, Volume 2, Acquisition and Support of Computer Resources in Systems.

Early requirements in this area will be available in the SOC. The SOW will also have tasks for this area, but the SOC will be the best source document for requirements.

The LSA output area most related to this consideration is the D-record data sheet. This is the Maintenance and Operator Task Analysis data sheet.

11. Computer Program Support--Software Support Center.

Responses for this area indicated that this decision would be a joint one between AFSC and AFLC. It was also evident that this area is one where a firm requirement needs to be known early in the acquisition process for major systems. This decision should be made prior to or during the conceptual phase of the acquisition process. The decision would be based on mission requirements, estimates of

software support workload, and cost studies. The specification requirement for this area would need to include provisions for adequate documentation and basically supportability characteristics to be included in the design of the computer program. This would be required even if planning was for the contractor to provide software support. It would be vital if a Government center was tasked with the support. Computer programs cannot provide adequate performance if they do not possess both an excellent design and good maintainability characteristics.

Requirements concerning the software support center would most likely be available in the SOC. Again this requirement would be available in the SOW and the CRISP, but for an input to the system specification, the SOC would be the best source.

The LSA output area most related to this consideration would be the E-record data sheet. This is the Support and Test Equipment or Training Material Description and Justification.

12. Additional Recommended Considerations for MIL-STD-490.

Responses from subjects on this area were varied and not all subjects had specific considerations to offer. Several indicated that the requirement for a standard Higher Order Language (HOL) should be included in this area of the

system specification. This requirement is probably more appropriate in paragraph 3.3.8 of the system specification, but it may be included in this section also, and it must be included somewhere in the system specification to be more enforceable. It will also be addressed later in a Computer Program Development Specification.

Another area cited was the need to centralize the control of support equipment to reduce the proliferation that has occurred. Basically, stronger requirements need to be introduced somewhere in the system specification to ensure that better use of MIL-HDBK-300 (USAF), Technical Information File of Support Equipment, is made.

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The results of the research are summarized in Table 2. Table 2 lists each logistics consideration addressed by the interview questions. For each logistics consideration the table shows the primary source of related requirements, the document that would most likely contain the requirement, whether the consideration is appropriate in the system specification, the related LSA output area, and whether the initial requirement would be a firm one.

Research Question One

Research question one asked what types of logistics requirements must be specified early in the acquisition process. For the research, the considerations required by MIL-STD-490 for inclusion in paragraph 3.5 of the system specification were selected. Two additional considerations that have been recommended for paragraph 3.5 by the MITRE report were included as well. Analysis for this research question was performed by using the corresponding column in Table 2 and the responses to the open-ended question. As shown in Table 2, all logistics considerations addressed by the research were considered to be necessary early require-

Table 2

Summary of Research Results

Logistics Consideration	Determining Agency	Source Document	Appropriate in MIL-STD-490	Related LSA Area	Firm Initially
1. Multipurpose Test Equipment	User	SOC	Yes	202	Yes
2. Rpr/Repl Criteria	User	SOC	Yes	303	No
3. Levels of Maintenance	User	SOC/SOC	Yes	303	No
4. Maint and Repair Cycles	User	SOC	Yes	401	Yes
5. Accessibility	User	SOC	Yes	B-Record	No
6.a New Supply Items	N/A	-	Yes	402	No
6.b Re-supply Methods	User/ALC	SOC	Yes	402	No
7. Distribution Of Stocks	ALC	SOC	Yes	202	No
8. Existing Facilities	User/ALC	SOC	Yes	F-Record	No
9. New Facilities	User/ALC	SOC	Yes	F-Record	No
10. Support Functions	User	SOC	Yes	D-Record	No
11. Support Center	AFLC/AFSC	SOC	Yes	E-Record	No

ments areas. A majority of the sample members strongly supported this issue for every area. In addition, the open-ended questions provided no additional areas that need to be addressed with early requirements or constraints. It is concluded that the major logistics requirements areas were addressed by the research. The maintenance areas are the most critical and will many times drive requirements for supply and facilities. This will occur because, as repair times and levels are dictated, the supply system must react to support these decisions. The maintenance issues should be the primary considerations as the system specification is generated. Requirements relating to the introduction of new supply items into the supply system, although addressed through other means within the systems engineering process, should continue to be addressed in the system specification. It is suggested that there are a number of detailed issues within the Computer Program Support area that should be defined and added to MIL-STD-490.

Research Question Two

Research question two asked what agencies or commands would establish early requirements or constraints for the subject logistics considerations. The results, shown in Table 2, indicate that the using command would be the dominant force in establishing early logistics requirements. For a few of the areas, the prime ALC for the system would

also make significant inputs concerning requirements.

Looking at the table, a relationship appears to exist between the different logistics areas and the primary source of requirements for those areas. This relationship seems almost obvious at this point in the project, but it was not obvious at the beginning. The observed relationship is that the maintenance requirements (which have been described as the most critical), are addressed by the user who in reality must live with the maintenance characteristics of the system in accomplishing the (most critical) operational mission. Also the supply requirements, which are secondary to maintenance, are addressed more by the ALC, which in reality must live with the supply characteristics of the system design in fulfilling the user's needs. The other two major areas of Facilities and Computer Program Support must be addressed by both the user and the ALC. The impacts of these two areas are significant for both agencies, and each has their own purposes for addressing the two areas. The above relationships indicate that we must place different emphases on requirements depending on the particular areas that the requirements address.

Research Question Three

Research question three asked what document would contain the subject early logistics requirements once they were identified. From Table 2, it is evident that the SOC

should be the primary source document to be used in generating logistics requirements for the system specification. The SOC is either the primary source, or one of the best sources, for every logistics area addressed. This does not mean that every SOC will address every logistics area, but it does mean that the SOC is the most likely document to address it.

This is a reasonable conclusion in light of the SOC's role and how it is prepared. The SOC is originally generated during the conceptual phase as a preliminary system operational concept(PSOC). A PSOC is prepared by the operating command in conjunction with the implementing, participating, and supporting commands for each proposed alternative solution. For each alternative solution that is selected for the demonstration and validation phase, the PSOC is refined and expanded by the operating command working with the implementing, supporting and participating commands. This document becomes the SOC and will be tailored and updated as the program proceeds (19:9).

The SOC is produced subsequent to the Statement of Operational Need (SON). It does address requirements, and it is formed as a joint effort among the user and other commands. Both its timing and its purpose make it the best source for early logistics requirements. This is verified by the research results. An outline of the issues that are

required to be addressed by the SOC is included in Appendix E. The maintenance concept portion (para. 8.a.(3) and 8.b.) of the SOC will provide most of the data concerning logistics requirements.

A Final Comment

What is vital to acquisition logistics is the ability to make a decision on a logistics requirement at the optimum point in time. It is evident from studies and LCC curves that the earlier a decision is made, the more impact it will have on total LCC. However, an early decision can be a poor decision and may contribute to an increase in total LCC. What is necessary is not always an early decision, but rather the right decision at the right time. As pointed out by Harrison, "Decisions have an optimum time at which the maximum probability for success occurs. The relative success of a decision is therefore directly related to the time when it is made [8:327]." How can we make the right logistics decision at the right time?

In order to achieve this ideal objective, we need adequate information. The Logistics Support Analysis process has the ability to provide this information if it is performed throughout all phases of the acquisition process. What is currently lacking is sufficient emphasis on the accomplishment of LSA by Government agencies during the conceptual phase of the acquisition process. The user is in a

key position to perform preliminary analyses. Required inputs for the SOC should result from user analyses using some form of LSA. It is difficult to make a "right" decision when there has been no analysis of alternatives. LSA needs to be actively conducted much earlier for programs. Then when we come to the point where a decision needs to be made about a particular supportability issue, the information (analysis results, alternatives, tradeoffs) will be available to make the right decision. Only then will we be able to make optimum decisions.

Recommendations

There are several areas recommended for future study and effort. One needed area is a better determination of the Computer Program Support issues that should be addressed by MIL-STD-490 for paragraph 3.5 of the system specification. There are many Computer Resources staff offices that would be excellent sources of information in this area. The AFALD/PTEC office (Embedded Computers) would like a research effort done to generate the wording for the requirements for each computer software consideration area.

Another recommendation is for other ILS related elements specified in the system specification (i.e. Reliability and Maintainability, Manpower Requirements and Personnel, Survivability, etc.) to be studied. A similar analysis could be performed on them as has been done in this project

on Maintenance, Supply, and Facilities.

A final recommendation, which is not a new one, is offered with a new motivation. The recommendation is that a specification handbook be written on logistics requirements. This handbook would essentially be a Mil-Prime specification for logistics requirements. Requirements, similar to the few included in the analysis chapter, would be gathered from many sources, organized by logistics area, and compiled in the specification. A fair effort at such a document is contained in Appendix A to AFP 800-7, Integrated Logistic Support, Implementation Guide for DoD Systems and Equipment. This was published in March 1972 and much could be added to its appendix.

The need for such a document is evident, for it will allow those writing the system specification to develop the logistics portion with some known requirements areas and associated justifications. One other motivation for such a document is offered, relating back to the section on making the optimum decision. If such a logistics specification were available for those commands developing the SON, PSOC, and SOC; they would be able to use the specification and choose from alternatives for each logistics area in stating initial requirements. These initial requirements are preliminary decisions. The decisions may be changed later, but the requirement area has been addressed, and a departure

point has been established. When we have the needed information from the LSA process, we can lock in the requirement with a firm optimum decision. If supportability issues can be addressed in this manner, their contribution to LCC can be finally minimized.

APPENDIX A

LSA TASK PURPOSES AND DESCRIPTIONS

GENERAL

This appendix provides a limited amount of information on the LSA tasks which are described in MIL-STD-1388-1A. More detailed and comprehensive information is available in MIL-STD-1388-1A. This appendix provides a breakout of the LSA tasks and subtasks by major area along with the purpose of each major task area.

Major Task Area: 100 - Program Planning and Control

Purpose: To Provide for Formal Program Planning and Review Actions

Tasks/Subtasks

101 - Development of an Early Logistic Support Analysis Strategy

- 101.2.1 - LSA Strategy
- 101.2.2 - Updates

102 - Logistic Support Analysis Plan

- 102.2.1 - LSA Plan
- 102.2.2 - Updates

103 - Program and Design Reviews

- 103.2.1 - Establish Review Procedures
- 103.2.2 - Design Reviews
- 103.2.3 - Program Reviews
- 103.2.4 - LSA Review

Major Task Area: 200 - Mission and Support Systems Definition

Purpose: To establish supportability objectives and supportability related design goal, thresholds, and constraints through comparison with existing systems and analyses of supportability, cost, and readiness drivers.

Tasks/Subtasks

201 - Use Study

- 201.2.1 - Supportability Factors
- 201.2.2 - Quantitative Factors

- 201.2.3 - Field Visits
- 201.2.4 - Use Study Report and Updates

202 - Mission Hardware, Software, and Support System Standardization

- 202.2.1 - Supportability Constraints
- 202.2.2 - Supportability Characteristics
- 202.2.3 - Recommended Approaches
- 202.2.4 - Risks

203 - Comparative Analysis

- 203.2.1 - Identify Comparative Systems
- 203.2.2 - Baseline Comparison System
- 203.2.3 - Comparative System Characteristics
- 203.2.4 - Qualitative Supportability Problems
- 203.2.5 - Supportability, Cost, and Readiness Drivers
- 203.2.6 - Unique System Drivers
- 203.2.7 - Updates
- 203.2.8 - Risks and Assumptions

204 - Technological Opportunities

- 204.2.1 - Recommended Design Objectives
- 204.2.2 - Updates
- 204.2.3 - Risks

205 - Supportability and Supportability Related Design Factors

- 205.2.1 - Supportability Characteristics
- 205.2.2 - Supportability Objectives & Associated Risks
- 205.2.3 - Specification Requirements
- 205.2.4 - NATO Constraints
- 205.2.5 - Supportability Goals and Thresholds

Major Task Area: 300 - Preparation and Evaluation of Alternatives

Purpose: To optimize the support system for the new item and to develop a system which achieves the best balance between cost, schedule, performance, and supportability.

Tasks/Subtasks

301 - Functional Requirements Identification

- 301.2.1 - Functional Requirements
- 301.2.2 - Unique Functional Requirements
- 301.2.3 - Risks
- 301.2.4 - Operations and Maintenance Tasks

- 301.2.5 - Design Alternatives
- 301.2.6 - Updates

302 - Support System Alternatives

- 302.2.1 - Alternative Support Concepts
- 302.2.2 - Support Concept Updates
- 302.2.3 - Alternative Support Plans
- 302.2.4 - Support Plan Updates
- 302.2.5 - Risks

303 - Evaluation of Alternatives and Tradeoff Analysis

- 303.2.1 - Tradeoff Criteria
- 303.2.2 - Support System Tradeoffs
- 303.2.3 - System Tradeoffs
- 303.2.4 - Readiness Sensitivities
- 303.2.5 - Manpower and Personnel Tradeoffs
- 303.2.6 - Training Tradeoffs
- 303.2.7 - Repair Level Analysis
- 303.2.8 - Diagnostic Tradeoffs
- 303.2.9 - Comparative Evaluations
- 303.2.10- Energy Tradeoffs
- 303.2.11- Survivability Tradeoffs
- 303.2.12- Transportability Tradeoffs

Major Task Area: 400 - Determination of Logistic Support Resource Requirements

Purpose: To identify the logistic support resource requirements of the new system in its operational environment(s) and to develop plans for post production support

Tasks/Subtasks

401 - Task Analysis

- 401.2.1 - Task Analysis
- 401.2.2 - Analysis Documentation
- 401.2.3 - New/Critical Support Resources
- 401.2.4 - Training Requirements and Recommendations
- 401.2.5 - Design Improvements
- 401.2.6 - Management Plans
- 401.2.7 - Transportability Analysis
- 401.2.8 - Provisioning Requirements
- 401.2.9 - Validation
- 401.2.10- ILS Output Products
- 401.2.11- LSAR Updates

402 - Early Fielding Analysis

- 402.2.1 - New System Impact
- 402.2.2 - Sources of Manpower and Personnel Skills
- 402.2.3 - Impact of Resource Shortfalls
- 402.2.4 - Combat Resource Requirements
- 402.2.5 - Plans for Problem Resolution

403 - Post Production Support Analysis

403.2 - Post Production Support Plan

Major Task Area: 500 - Supportability Assessment

Purpose: To assure that specified requirements are achieved and deficiencies corrected.

Tasks/Subtasks

501 - Supportability Test, Evaluation, and Verification

- 501.2.1 - Test and Evaluation Strategy
- 501.2.2 - Objectives and Criteria
- 501.2.3 - Updates and Corrective Actions
- 501.2.4 - Supportability Assessment Plan (Post Deployment)
- 501.2.5 - Supportability Assessment (Post Deployment)

APPENDIX B

STRUCTURED INTERVIEW QUESTIONS

1. What is your current job position?(Title and Organization)
2. How many years have you worked with Logistics Support Analysis?
3. How many years have you worked with logistics support as a field?
4. How many years have you worked with the acquisition process?
5. How many programs have you worked LSA on?
6. Through which phases of the acquisition process have you worked LSA?
7. Would you consider the programs you have worked LSA on to be major programs or non-major?
8. When addressing system level logistics issues, we may establish objectives or constraints concerning the types and quantities of test equipment or support equipment that will eventually be required to support the system(ATE, MATE, BIT, etc.). Support equipment currently in the government inventory should be considered as a first choice whenever possible. We may also require the use of multipurpose test equipment for some programs.
 - a. What agencies or commands generate(or should generate) constraints or objectives in this area of support equipment and especially test equipment?
 - b. What document, such as the DCP, MENS, SON, etc., would contain this information?
 - c. What section of the LSA data or task/subtask outputs, later provided by the contractor, will confirm and/or amplify these initial requirements?
9. On many systems the maintenance concept, or certain key parameters within it, are known and are a major characteristic of the system.
 - a. Who would determine guidance or objectives on repair/replace criteria of the agencies concerned with this requirement?(AFLC, User, HQ AF, etc.)
 - b. What document or decision instrument will contain this information?

- c. Which area of the LSA task and data output will be impacted by this input and should show us how well this requirement was integrated into the design?
10. Another area of the maintenance concept is guidance on repair levels. This would include whether there should be two or three levels(org-inter-depot) and the type of subsystems or components that the different levels would be responsible for.
- a. What command or agency would make these types of decisions or objectives?(AFLC, User)
 - b. What program document would contain this type of information?(PMD,SON)
11. Another potential maintenance topic is system/item repair and maintenance cycles and criteria related to these.
- a. Which functions or offices would make decisions concerning these requirements or if not decisions at least objectives for the system?
 - b. Which documents would contain either the objectives or the associated criteria?
 - c. What section of the LSA output will show how well this data was integrated into the design?
12. The need for various accessibility requirements to be established, for maintenance purposes, is essential.
- a. What agency or command would establish accessibility constraints or requirements?
 - b. What type of document would contain these constraints once they were established?
 - c. Is there an area of LSA output that relates to accessibility requirements?
13. Concerning requirements related to the Supply areas, we should specify any constraints concerning the weapons system's impact on the supply system and any constraints that the supply system might place on the weapon system design. These requirements should address the introduction of new items into the supply system:
- a. What agency or command would establish constraints or guidelines for this area?

- b. In what type of document would this information be published?
 - c. Is there an area of LSA output that relates to this requirement area?
- 14. For requirements or constraints relating to distribution and re-supply methods:
 - a. What command or office would establish these types of requirements?
 - b. What document would state these requirements?
 - c. Is there an LSA output area that addresses such constraints?
- 15. Concerning requirements relating to facilities; we should specify any impact the weapon system might have on existing facilities and facility equipment, and if appropriate, the use of existing facilities.
 - a. What agency or command would establish these requirements and formulate them?
 - b. In what document(s) would these be published?
 - c. Is there an LSA output area that relates to facilities requirements?
- 16. For facilities requirements, we should also specify any decisions relating to needs for new facilities and developing new facility or auxiliary equipment.
 - a. What command or office would make these types of decisions?
 - b. In what document would these be published?
 - c. Is there LSA documentation that would relate to this area?
- 17. With the tremendous growth in computer applications in weapons systems, a number of problems have developed with regards to the development and procurement of these items and their software? MIL-STD-490 was written in 1968, prior to the development of computer applications in almost every aspect of weapons systems. We need to now be concerned with requirements related to ATE, BIT, Test Program Sets (TPS), Documentation, Data Rights, etc. Guidelines relating these areas to system design requirements should be established early.

- a. For Computer Program Support, what command or agency would identify the support functions to be provided at the operating site(s)?
 - b. What might some of these functions be?
 - c. What document would this type of information be provided in?
 - d. Are any of the LSA outputs related to this area?
18. The area of software support can be a major cost driver in systems requiring computer applications.
- a. What agency or command would determine who would be responsible (contractor, Government center) for making modifications to and supporting the software once the system is operational?
 - b. What document would contain this guidance?
 - c. Is there an area of LSA documentation that relates to this subject?
19. The above logistics requirements areas are by no means exhaustive, especially in the area of supporting computer applications. There are other logistics areas which receive attention early in the program and for which requirements should be included in the system specification. From your experience in either acquisition or logistics efforts, what other such areas have you become aware of that have requirements or decisions made concerning them available as a result of early studies?
- a. What agencies or commands did the particular studies and developed the requirements?
 - b. What documents contained these requirements once they were determined?
 - c. What area of the LSA process does this logistics area relate to most closely and with which it could be compared to evaluate the success of LSA?

APPENDIX C
THE ACQUISITION PROCESS

GENERAL: This appendix provides a brief introduction to the acquisition process. It is not a thorough discussion, but is intended to provide a basic familiarization. Additional information can be found in Department of Defense Directive 5000.1, "Major System Acquisitions," and Department of Defense Instruction 5000.2, "Major System Acquisition Procedures."

The Acquisition Process

The acquisition process is, by its nature, very complicated and complex. It is participated in by a myriad of agencies, commands, and decision-making bodies, from the using or operating command in the Air Force up to and including the President and the Congress. The Office of Management and Budget (OMB) Circular A-109 describes the acquisition process as:

The sequence of acquisition activities starting from the agency's reconciliation of its mission needs with its capabilities, priorities and resources, and extending through the introduction of a system into operational use or the otherwise successful achievement of program objectives [11:3].

This sequence of activities is often referred to as an acquisition cycle. The cycle begins with the identification of a mission need and related requirements being established. During the Conceptual phase, alternative systems and concepts are evaluated for satisfying the need. The most promising alternative(s) is further defined and evaluated during the Validation/Demonstration phase. The Full Scale Development phase follows to accomplish the

development of a final design and a rigorous program of test and evaluation of that design. If the developed system meets the mission requirements and has a priority such that funds are allocated for its procurement, then production begins. The system is then fielded and becomes operational. Over a period of years changes occur in technologies, missions, and threats which require changes and modifications to the system. Ultimately, it cannot be modified further, and the cycle must begin again with updated mission needs.

The OMB and the Office of Federal Procurement Policy (OFPP) describe the major system acquisition cycle as consisting of seven distinct phases. A description of the seven-phase cycle is provided below. The Department of Defense and the Air Force implement this seven-phase cycle by progressing through four major decision points known as milestones. This decision point structure is used in order to achieve cost effectiveness and risk reduction at each point in the life cycle. The time periods before and after each milestone are referred to by DoD as phases with the descriptions being very similar to those of OFPP's corresponding seven phases. The DoD's structure essentially uses five phases.

For each of the four milestone decision points, a program can either: (1) be approved for the next phase of the cycle, (2) have further studies conducted by the Air

Force, or (3) be discontinued. At each milestone decision point, the appropriate decision authority must make one of these choices for a given program. The appropriate decision authority for each program is established based upon such factors as the estimated program cost, single or multiple services involvement, Allied involvement, and the urgency of need. The Secretary of Defense (SECDEF) will designate any new systems that are to be managed as major systems. For those, the SECDEF is the decision authority. He will receive recommendations from the Defense Systems Acquisition Review Council (DSARC). DSARC review and SECDEF approval is required on major programs for Milestones I and II. Air Force programs that are not major, but that are critical and subject to high level review are referred to as Air Force Designated Acquisition Programs (AFDAP's). For these programs, the Secretary of the Air Force is the decision authority at each milestone. He will receive recommendations from the Air Force System Acquisition Review Council (AFSARC). For less than major programs that are not categorized as AFDAP's, the Air Staff will be the decision authority.

The discussion that follows describes the acquisition process for major system acquisitions. For less than major programs the process is very similar except for the review and approval levels. It should be noted that, for many programs, one or more of the phases requires many

iterations and the cycle itself is not accomplished at a smooth and steady pace.

1. **Mission Analysis:** A continuing analysis effort by a federal agency of current and forecasted mission capabilities, technological opportunities, overall priorities, and resources that are involved for meeting the national needs that are the responsibility of that agency.

2. **Evaluation and Reconciliation of Needs in Context of Agency Mission, Resources, and Priorities:** When mission analysis identifies a deficiency in existing agency capabilities or an opportunity to establish new capabilities in response to a technologically feasible opportunity, this is formally set forth in a mission need statement (Mission Element Need Statement, MENS). The mission need statement includes the mission purpose, capability, agency components involved, time constraints, value or worth of meeting the need, relative priority, and operating constraints, and is not to be expressed in terms of equipment or other means which might satisfy the need. Approval or validation of a mission need statement by the appropriate authority, the SECDEF for major systems, represents Milestone Zero/Program Initiation Decision in the DoD acquisition cycle.

3. **Exploration of Alternative Systems (the Conceptual Exploration Phase for DoD):** Approval of the mission need formally starts the major system acquisition process by

granting authority to explore alternative system design concepts. During this phase, a program manager is designated and an acquisition strategy is developed. One of the key steps in the implementation of the acquisition strategy is the solicitation to industry in terms of the mission need instead of predetermined system characteristics. This solicitation is accomplished through the request for proposal (RFP). The responses from industry are then evaluated, and the most promising system design concepts are selected for further exploration. Parallel short-term contracts may be let for those concepts selected for further exploration. The alternative system design concepts selected for consideration for competitive demonstration are submitted by the Secretary of the Air Force to the SECDEF for approval. SECDEF approval to proceed into the Demonstration and Validation phase represents Milestone I/Requirement Validation Decision.

4. Competitive Demonstrations (the Demonstration/Validation Phase for DoD): Competitive demonstrations are intended to verify that the chosen concepts are sound, perform in an operational environment, and provide a basis for selection of the system design concept(s) to be continued into full-scale development. Such demonstrations normally involve some type of hardware prototype, but can be just paper studies or a combination of the two. The aim of this phase is reduction of technical risk and economic uncertainty by

achieving a more detailed definition of the new system. Contractors will respond during this phase to the Request for Proposal (RFP) prepared by the Government. Sometimes two contractor proposals will be selected for advancement into the next phase (FSD) of the process, if they satisfy the system requirements. At the end of this stage, a Milestone II review is conducted by the AFSARC, the Secretary of the Air Force, and the DSARC. If the SECDEF grants his approval at this point, Milestone II is achieved (Program Go-ahead Decision) and the Full Scale development phase is entered.

5. Full-Scale Development, Test, and Evaluation (the Full-Scale Development Phase for DoD): During this phase, the system and its associated support systems are designed, developed, fabricated and tested. The objective of this phase is to develop initial production prototypes and the associated documentation needed to produce and support the system.

Testing and Evaluation are also a significant part of the effort accomplished during this phase. The primary purpose of test and evaluation (T&E) is risk reduction. T&E is the only method of demonstrating that the program objectives are being achieved, and it also provides information necessary for program decisions and pertinent recommendations. Testing and evaluation are required by DODI 5000.2 to begin as early as possible in the acquisition process. A thorough

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AN IMPROVED METHOD FOR DETERMINING LOGISTICS
REQUIREMENTS FOR THE SYSTEM SPECIFICATION(U) AIR FORCE
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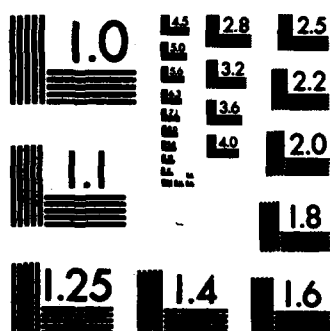
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evaluation of all aspects of the system is required prior to a full-scale production decision. Once adequate testing is completed, the point has been reached where a Milestone III decision must be made. This is the Production decision. If no major program changes have occurred, the Secretary of the Air Force can make the Production decision.

6. Production(the Production Phase for DoD): During this phase, the system and all support elements are produced for operational use. Some testing that was not completed during FSD will continue. Also during this phase program management responsibility transfer (PMRT) occurs. PMRT is the transfer of the responsibility for managing a program from AFSC to AFLC.

7. Deployment and Operation: As produced systems become available, they are deployed into operational use, thereby providing the capability originally identified in the mission need statement. This new capability then becomes a factor in the continuing mission analyses of the agency, and the major system acquisition cycle continues.

[11]

Air Force Acquisition

The Air Force agency responsible for developing and acquiring new weapon systems is Air Force Systems Command(AFSC). AFSC is comprised of five major product divisions and other smaller specialized organizations. The

five product divisions represent logical divisions in the spectrum of weapons systems being procured. The five product divisions are the Space Division (SD), the Aeronautical Systems Division (ASD), the Ballistic Missile Office (BMO), the Electronic Systems Division (ESD), and the Armament Division (AD). When a need has been identified and the acquisition cycle has begun for a new system, it is considered an acquisition program. It will usually be assigned to a product division even before the milestone zero decision has been made.

The workhorses of the product divisions are the System Program Offices (SPO's). A SPO is the single point of contact for any government or industry agency involved with the acquisition of a particular system. A SPO may be responsible for only one major program, such as in the B-1B program. However, a SPO could be responsible for several programs of different sizes and in different phases of the acquisition process ("basket SPO"). For every active program, a program manager (PM) is designated and the PM is the single Air Force manager responsible for that acquisition program. He is the person in charge of the whole program. The PM has a tremendous amount of responsibility and with it the needed authority to ensure successful conduct of the acquisition.

Whether the program is large or small, the PM:

..must pull together many resources and orchestrate the efforts of the SPO, the contractor, the participating commands, and other agencies to effectively develop, produce, and deploy the weapon system or product [7:19].

The SPO is composed of several functions which are all required for the successful execution of any program. The functional offices within the SPO usually include engineering, logistics, test, deployment, business management, configuration management, contracting and manufacturing. All of these functional areas must interact successfully in order to achieve a balance among the efforts of their individual specialities and ultimately an optimum product.

This thesis is especially aimed at improving the interaction between the logistics and engineering functions by determining where certain logistics criteria, known early in the process, could be found and therefore made available to the engineering function when it prepares the system specification.

APPENDIX D

LOGISTICS AND SYSTEM ENGINEERING

GENERAL: This appendix provides some further background on Integrated Logistics Support, Logistics Support Analysis, and System Engineering. Logistics Support Analysis supports ILS, but is accomplished in conjunction with System Engineering. The success of any program will depend on the quality of interaction between these two disciplines.

Integrated Logistics Support

Integrated Logistics Support(ILS) has become one of the major elements in defense system programming and acquisition. ILS has been alive officially since 1964 when DoD Directive 4100.35, "Development of Integrated Logistics Support for Systems and Equipment," was published. ILS has the objective of achieving "an optimum balance between total system performance, cost, and schedule while developing an integrated support system [4:59]." The motivation for ILS is the significant portion of a system's total LCC that goes toward operating and support expenses. ILS, like any new program or discipline, had to receive the proper attention of both industry and government agencies in order to begin to play its intended role. Some of the key points stressed early in the life (1965) of ILS were:

1. ILS is necessary for the development of an effective and economical support system.
2. For the most part, the cost of ownership of weapon systems far exceeds the development and investment costs.
3. The cost of ownership of weapons systems is most effectively controlled by emphasis on ILS as early in

the conceptual phase of the system as possible.

4. ILS represents the start-to-finish life-cycle planning of total maintenance and logistics support of weapon systems. [4:60]

As these ideas took hold in the defense and industry circles, interest and support for ILS grew. ILS became more refined and was better defined as a concept. Procedures were developed for implementing ILS into the acquisition process. The Air Force implemented major ILS efforts within the original B-1 program and with the F-15 program. The SPO's for both of these programs had ILS offices within them and the ILSO's were given the responsibility and authority commensurate with their intended function. After these two major programs, ILS became a standard for most other programs and eventually a mandatory element for any acquisition program.

ILS did not, however, become an effort that could be successfully accomplished without difficulty. Obstacles to achieving the intended benefits of ILS still exist. Concern over the up-front cost for ILS, when a program manager is trying to do the most he can within budget constraints, has been and is a real problem. Other obstacles also exist, but this is the primary one. This obstacle reflects essentially short-sighted and parochial planning as described below:

The concept of making early, relatively small investments in order to realize a lower life cycle cost is central to the ILS philosophy. Only when ILS is

implemented early and afforded a chance to impact design can the intent of ILS be met [4:61].

LSA as a process addresses a number of the ILS elements and, when accomplished properly, it provides a means of overcoming some existing obstacles. It is proposed that the use of a logistics specification, written in the Mil-Prime format, would also be extremely useful in the formation of system specification requirements. Such a document would provide the means for establishing enforceable and verifiable logistics requirements and a way around many of the obstacles to achieving the goals of ILS.

The ILS Elements

Integrated Logistics Support originally consisted of seven basic elements. The number of elements of ILS has changed over the years (11,13,10,etc.) and now stands at 15. Air Force Regulation 800-8, Integrated Logistics Support Program, lists and defines the current 15 elements as shown below. Included with each element is a keyed symbol to indicate the elements relationship to requirements in MIL-STD-490. At the end of each element, an (A) is added if MIL-STD-490 has requirements for much of this information to be specified in the system specification but not in the logistics section (para 3.5). A (B) is added if MIL-STD-490 requires much of this information to be specified in the logistics section (para 3.5) of the system specification.

No symbol is added if the element's information is not required by MIL-STD-490.

1. Reliability and Maintainability(R&M): R&M are key design parameters that influence both the performance(mission effectiveness, system availability) and economics(support requirements,LCC) of a weapon system. R&M are true engineering design parameters and are normally managed by the engineering division of a program office. (A)

2. Maintenance Planning(MP): MP is conducted to establish concepts and requirements for on- and off-equipment maintenance to be performed during the life of the system or equipment. This process begins early in the acquisition cycle with the development of the maintenance concept. (B)

3. Support Equipment(SE): The purpose of the SE element of ILS is to ensure that the required equipment is available to operating, maintenance, and training activities when needed. SE includes all equipment required to perform the support function, except that which is an integral part of the mission equipment. (B)

4. Supply Support(SS): Supply support includes provisioning for initial support, as well as acquiring, distributing, and replenishing inventory spares and repair parts, and performing special studies. (B)

5. Packaging, Handling, and Transportation(PHT): This element includes the requirements, resources, and procedures necessary to ensure that all system, equipment, and support items are transported, preserved, packaged, and handled properly. (A)

6. Technical Data(TD): TD is the information needed to translate system and equipment requirements into discrete engineering and logistic considerations. TD is the communications link between the designer and the user.

7. Facilities(FA): The FA program ensures that all required facilities are available to operating forces and supporting activities, concurrently with the prime system and equipment. (B)

8. Manpower Requirements and Personnel(MRP): Manpower requirements are developed and personnel assignments

are made to meet mission support demands throughout the life cycle of a system. (A)

9. Training and Training Support(TTS): The TTS element defines qualitative and quantitative requirements for training of operating and support personnel throughout the system's life cycle. (A)

10. Logistics Support Resource Funds(LSRF): In ILS planning, management must consider the interface between support element needs and defense budgeting and financing procedures, during all phases of the equipment life cycle. Because of their importance in implementing logistics support, budgeting and financing activities are included as prime elements of support management.

11. Logistics Support Management Information(LSMI): LSMI includes all information generated for or used by both Government and contractor ILS managers, in planning for and acquiring the other elements of ILS.

12. Computer Resources Support(CRS): Computer resources comprise a significant part of current systems and equipment and include special purpose computer program documentation, related software, and source data. This element in ILS is usually planned and developed by a computer resources working group (CRWG), which documents the approach in a computer resources integrated support plan(CRISP). (A)

13. Energy Management(EM): ILS must consider energy requirements and constraints in providing effective and economical support to systems and equipment throughout their life cycle.

14. Survivability(SV): The survivability of the system is vital to accomplishing the intended mission. An integral part of ILS planning is to preserve the survivability design features during the system's life cycle. (A)

15. ILS Test and Evaluation(ILS T&E): This includes planning for testing and evaluating the support system during development and operational testing. (A)

As can be seen from the objective of ILS and the elements above that comprise it, ILS must be a part of every

phase of the acquisition process. The conduct of an ILS program for a major weapons system acquisition is a very demanding task, requiring the best from experts in the logistics field and many iterations of studies, analyses, and plans. It is an effort participated in by many agencies, including the contractor, the program office, AFLC, the using command and others. However, as complex as ILS might be to accomplish for any given program, it is only a portion of the total acquisition process for that program.

Logistics Support Analysis

Logistics Support Analysis(LSA) is both a process and an approach. It is an iterative process that is accomplished with the system design effort, and which should begin at the earliest stages of a program's life cycle. It is a process that takes place within the system engineering process to accomplish the logistics engineering effort. LSA is a dynamic process that takes the design into account in determining support requirements and affects the design in light of the design's impact on support requirements. LSA is therefore an approach to accomplishing the major objectives of ILS. The different elements of ILS are able to interact with each other and with other disciplines through LSA. The result of LSA is a single data base for logistics information including the results of analyses and actual

decisions made. From this data base, an output is available that provides specific support requirements. The objectives of support analysis are to:

1. Cause supportability requirements to be an integral part of system requirements and design.
2. Define support requirements that are optimally related to the design and to each other.
3. Define the support required during the operational phase.
4. Prepare attendant data products.

[21:111]

LSA has the ability to accomplish these objectives because it is in reality two distinct efforts which are conducted together. These two efforts depend on each other and have been referred to as informal and formal (23). The informal aspect of LSA is that part which is composed of the conduct of studies, tradeoffs, and analytical efforts. This part of LSA must be accomplished throughout the life cycle of a system and most importantly prior to and during the conceptual phase. In reality it does not receive sufficient emphasis until the Full Scale Development phase. As a result of the informal part of LSA, decisions or choices are made. Once such decisions are made, they form the basis for the formal LSA effort. The formal part of LSA is the development of the data base of logistics information mentioned above.

Logistics Support Analysis is described in MIL-STD-1388-1A. This standard provides the general requirements and task descriptions for the performance of support analysis throughout the life of a system to which it is applied. As described in MIL-STD-1388-1A, LSA is a responsibility of both the Government and the contractor. The tradeoff studies and analyses that are considered the informal part of LSA, would begin at the earliest stages of a program and be done solely by Government activities. Once the contractor became involved in the program, the performance of appropriate similar informal LSA efforts would be required of him. As the program proceeded and the design evolved, such analyses and studies would move to an increasing level of detail. This informal part of LSA, for both the Government and the contractor, would not end until the system is well into operation; but the flexibility to make any major changes relative to support areas would be very limited by the start of FSD.

MIL-STD-1388-1A also addresses formal LSA and the logistics data base that is to be developed. The specifics on what the data base should provide are contained in MIL-STD-1388-2A. The contractor is primarily responsible for the formation and development of this data base, and he can use either Government provided computer programs or contractor developed ones. The major requirement is that the output from such a data processing capability will yield the

required information. The types of studies and analyses that a contractor will be required to do, and the types of output information that will be required are described in various task descriptions in MIL-STD-1388-1A. The tasks in the standard will be tailored to the particular system and life cycle phase. The particular tasks required are listed as part of the Statement of Work (SOW), and the output information desired is described as part of the Contract Data Requirements List (CDRL) portion of a contract. The output from the LSA data base should be summary reports relating to specific logistics support areas (personnel and skill summary, repair parts list, etc.) or reports that can yield data for further studies and recommendations. The data base can be made available to Government representatives and agencies if this capability is tasked for in the SOW.

The main difficulty with LSA is that the output data it provides is not available during the early life of a system when the critical decisions are being made and requirements established. Fig. 2. shows two curves which illustrate this difficulty. Curve A shows the number of logistics decisions remaining in the life of the system. This number decreases as time passes. This decrease occurs because the developing design will dictate how logistics areas must be constrained to support the design. The curve indicates that logistics requirements areas need to have decisions on them made

early. Curve B shows how LSA data begins as essentially non-existent or minimal and increases with time. The need exists to obtain valid data at a much earlier point in the life cycle so that more logistics decisions can be made based on that valid data.

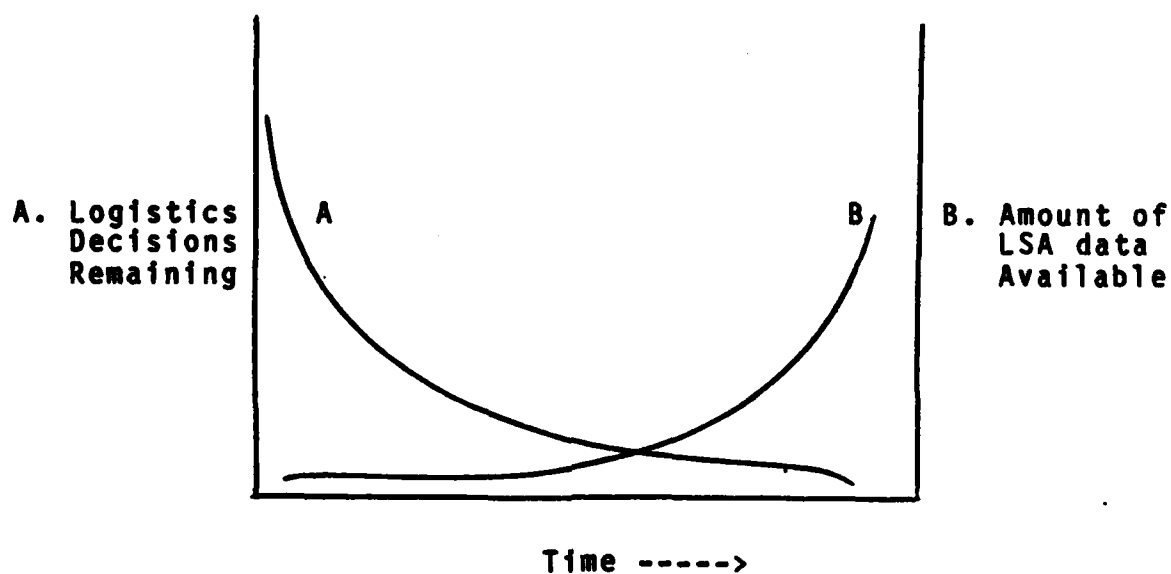


Fig. 2: LCC Impact versus LSA Data Availability

From the description of LSA, it is obvious that it is critical to the success of a program's ILS effort. Each of the 15 elements of ILS are supported by LSA. LSA has been described as being "the only analytical activity within the logistics field dedicated to providing guidance to the primary product design, and determining functional requirements for each of the logistics elements (16:STARR-1]." Once

again, LSA is not an end in itself, but one of the parts of the whole effort we go through to acquire systems with the best balance between cost, schedule, performance, and supportability.

Achieving this "optimum" balance among all requirements, needs, and objectives to acquire the best system with the least total life cycle cost is a dynamic and overwhelmingly complex process. It is a process in which we continuously aim for the ideal and plan as though we can achieve it. In reality, we find that optimization of a system with an essentially infinite number of constraints is not possible. Much room exists for improvements in our methods and procedures, and this thesis looks at how we can improve on just one small area. It is certain; however, that improvements in this small area can have significant cost and supportability impacts.

Engineering Management

Engineering Management, as defined by MIL-STD-499A, is "the management of the engineering and technical effort required to transform a military requirement into an operational system [20:3]." This effort is subordinate to program management and conducted by the engineering function within the SPO. Engineering dominates as the major function shaping the characteristics of the system being acquired. Engineering Management is essentially system engineering. It is used to define the system performance parameters and configuration needed to meet the identified requirements. Its aim is to conduct the development with a systems approach. To do this, system engineering must integrate and manage the efforts of various engineering areas including design engineering, test engineering, production engineering, and specialty engineering. The specialty engineering disciplines include reliability, maintainability, logistics, human factors, safety, and others. The detailed engineering efforts are usually accomplished by the contractor as a result of tasks levied on him. As a program progresses through the acquisition phases, systems engineering becomes an increasingly more detailed effort, beginning with a general system description or requirement(s), and culminating in the physical product to meet the actual

requirement.

Systems engineering and LSA are very closely related and must be accomplished together. Each effort affects the other and decisions made for either area must be weighed concerning their impacts on the total system outcome. System engineering aims to achieve a balance among operational (performance), economic (cost,LCC), and logistics (support) factors. This means that:

..the integration of ILS concepts and planning considerations into the system engineering process is a continual and iterative activity, with; the output being the optimal balance between performance and support considerations and optimal trade-offs among costs of ownership, schedule, and system effectiveness [20:8].

Within the SPO, the Deputy Program Manager for Logistics (DPML) and his Integrated Logistics Support Office (ILSO) are responsible for monitoring the logistics impacts of the system design as it evolves and for ensuring that the design considers logistics constraints. The contractor also plays a major role through his conduct of logistics engineering (establishing optimal logistics requirements) and logistics support analysis (defining support needs such as maintenance, equipment, spares, repair parts, etc.).

One of the primary responsibilities of the system engineering process is to generate system and subsystem specifications for program peculiar items in accordance with MIL-STD-490. These specifications will be refined to an

increasing level of detail as the program proceeds through the various phases. Maintaining control of this refinement process, with regard to functional and physical characteristics of the system, is the responsibility of the configuration management function within the SPO.

Specifications for program peculiar items are generated in accordance with MIL-STD-490 guidance and will typically be one of five types: system specification (Type A), development specification (Type B), product specification (Type C), process specification (Type D), and material specification (Type E). Program peculiar is a term that might be easily misunderstood. It is defined in MIL-STD-490 as:

Program peculiar items, processes and materials as used in this standard, include all items, processes and materials conceived, developed, reduced to practice or first documented for the development, procurement, production, assembly, installation, testing or support of the system/equipment/end item (including their components and supporting items) developed or initially procured under a specific program [20:1].

A system specification does address technical and mission requirements at a system level. It assigns requirements to various functional areas and defines the interfaces among functional areas. The initial system specification for a program would be based on parameters developed during the concept formulation period or from preliminary feasibility studies and analyses. During the Demonstration/Validation phase, the system specification is placed under Government

control. It may be updated by Engineering Change Proposals (ECP) as a program progresses. The final authenticated version of the system specification is a "future performance base for the development and production of the prime items and subsystems [22:3]." The Mil-Prime specification method, discussed in Chapter 1, is used to help form the initial or draft system specification. A Mil-Prime specification document and its associated handbook are used to generate the appropriate requirements for a given functional area's (e.g. landing gear, environmental control) portion of the system specification. It can be seen how a logistics specification would be very useful in providing a means of forming logistics requirements for program peculiar specifications. This would allow LSA to have a much earlier impact on the system design.

Development specifications address requirements for "the design or engineering development of a product during the development period [22:3]." They are more detailed than a system specification and address the specific performance characteristics that a subsystem or product are to achieve prior to production. Development specifications are classified by sub-types as: prime item, critical item, non-complex item, facility or ship, and computer program development specifications.

The third type of specifications are product specifica-

tions. This type can apply to any item below the system level and will address requirements that are primarily oriented toward the fabrication of the product, including the mandatory detailed design. Product specifications also have sub-types which correspond to those listed above for development specifications.

Process specifications apply to services which are performed on a product or material. A process specification will normally apply to production but may be established to address the development of a process. Material specifications apply to raw materials used in fabricating products. Again, material specifications normally apply to production, but may be established to address the development of a material.

The various types of specifications described in MIL-STD-490 provide a hierarchy of specifications. The amount and range of design detail increases as you proceed from the system specification down to product, material and process specifications. Each level of specification can also be modified to reflect later design realignments, through Government-approved changes, as you proceed through the acquisition process. The specifications go through many iterations before being placed under Government control, and some of the detailed information may not be finalized until well into the production phase.

An example may help to clarify the use of program peculiar specifications and their relationship to DODISS specifications and standards. If we wanted to write a specification for a B-1 weapon system, it would surely be considered a single application item, so the specification would be originated as a MIL-STD-490 system specification. The B-1 weapon system, however, would include many components or subsystems, such as a radio transceiver, that are also being used in other systems, so each could be "specified" using references to DODISS specifications and standards. The DODISS references would also be used for defining general performance requirements, such as definition of environmental conditions to be experienced by the aircraft. The combination of newly identified requirements and historically developed (DODISS) requirements would comprise the total system requirements. Then, as the system design evolved, new components and subsystems would be developed having application only to the B-1. Their requirements and design would be defined in additional program peculiar specifications. Ultimately, the final B-1 design would include components built to program peculiar specifications and components procured to military (DODISS) specifications, all meeting other general requirements specified in other military (DODISS) specifications and standards.

APPENDIX E

SYSTEM OPERATIONAL CONCEPT

GENERAL

The format for and items required in a System Operational Concept (SOC) are presented in this appendix. This appendix is composed of extracts from AFR 57-1, Statement of Operational Need (SON), Attachment 5. A preliminary system operational concept may be general, but, as a minimum, will address or reference the numbered headings in the format shown. Subitems will be addressed if the data is available. The numbered format headings are mandatory for all system operational concepts at the full-scale engineering development decision point update. At this time, the subitems must be completed or specifically identified as "not applicable". Additional items are included as necessary. As can be seen from the distribution list, the SOC will be received by many offices including AFLC, AFSC, and AFALD.

System Operational Concept Format Instructions

1. Preparation Instructions. Because of the diversity of Air Force systems, operational concept development must not be overly standardized. Different criteria are required for different systems and a flexible approach is necessary:

a. A preliminary system operational concept may be general, but, as a minimum, will address or reference the numbered headings in the format (1, 2,3,etc.). Address subitems if data is available.

b. The numbered format headings are mandatory for all system operational concepts at the full-scale engineering development decision point update. At this time, the subitems must be completed or specifically identified as "not applicable." Include additional items as necessary.

2. Distribution:

a. Draft preliminary system operational concepts, system operational concepts, and updates must be sent simultaneously to applicable commands and agencies listed below for review and comment before submission to HQ USAF for approval:

HQ ADCOM/XPX, Peterson AFB CO 80914.....	3 copies
HQ AFCS/XPQ, Scott AFB IL 62225.....	3 copies
HQ AFLC/XRXX, WPAFB OH 45433.....	12 copies
HQ AFRES/XPXX, Robins AFB GA 31093.....	2 copies
HQ AFSC/XR, Andrews AFB DC 20334.....	12 copies
HQ AFTEC/XR, Kirtland AFB NM 87117.....	6 copies
HQ ATC/XPQ, Randolph AFB TX 78148.....	6 copies

HQ MAC/XPQ, Scott AFB IL 62225.....	6 copies
NGB/XO, Wash DC 20310.....	6 copies
HQ PACAF/DOO, Hickam AFB HI 96853.....	6 copies
HQ SAC/XO/XP, Offutt AFB NE 68113.....	6 copies
HQ TAC/XP, Langley AFB VA 23665.....	6 copies
HQ USAFE/DPQ, APO New York 09012.....	6 copies
HQ USAFSS/XR, San Antonio TX 78243.....	6 copies
OC-ALC/XRX, Tinker AFB OK 73145.....	2 copies
OO-ALC/XRX, Hill AFB UT 84406.....	2 copies
SA-ALC/XRX, Kelly AFB TX 78241.....	2 copies
SM-ALC/XRX, McClellan AFB CA 95652.....	2 copies
WR-ALC/XRX, Robins AFB GA 31098.....	2 copies
AGMC/XRX, Newark AFS OH 43055.....	1 copy
AFALD/XRX, WPAFB OH 45433.....	10 copies

b. The operating command sends 15 copies of all applicable preliminary system operational concepts, system operational concepts, and updates to HQ USAF/X00 and one copy to HQ USAF/RDQ.

System Operational Concept

1. Introduction: A summary of the intended employment and posturing of combat forces.
2. Mission Task: A brief description of the operational need or reference to the proper SON or MENA.
3. Operational System(s): A description of the system(s) being developed to satisfy the operational need.
4. Operational Environment: A description of the environment (for example, weather, friendly system jamming, etc.) to be considered along with the validated threat assessment and updates.
5. Scope: State the objectives to be achieved, the expected interface with other systems, services, agencies, or allies, and those factors which influence the employment, deployment, and support of combat forces. Discuss constraints on operational concept development (for example, IOC, full operational capability, funding, etc.).
6. Employment (what and how):

NOTE: Establish quantitative or qualitative levels of system performance for all asterisked (*) items before the full scale engineering development decision point:

*a. Performance: How the system and significant elements

of the system must perform in its intended operational environment.

*b. Anticapted tactics.

*c. Availability:

(1) Operational reliability.

(2) Maintainability.

*d. Mission scenarios. How the system will be used to accomplish the mission under various scenarios:

(1) Sortie rate and duration.

(2) Mission mix.

*e. Utilization rates.

*f. Force structure.

*g. Command support.

*h. Survivability to both nuclear and nonnuclear attack, including electromagnetic field effects.

*i. Payload capability or system capacity.

*j. Command and control communications, to include backup communications.

*k. Interoperability.

l. Environmental effect factors (weather and atmosphere).

m. Spectrum considerations.

n. Standardization considerations.

o. Security (physical, operations, communications).

7. Deployment (where and when):

a. Use of main operating base (MOB).

b. Use of deployment operating bases.

c. Bare base.

d. Use of training bases, ranges, etc.

- e. Dispersal, hardening, and mobility requirements.
- f. Basing to include system distribution and configuration(s).
- g. Command and control communications at each location.

8. Support:

a. Manpower Requirements:

- (1) Staff support.
- (2) Operations (include crew ratio).
- (3) Maintenance.
- (4) Security police.
- (5) Base operating support.
- (6) Organization.

b. Logistics:

- (1) Maintenance plan (see AFR 66-14).
 - (2) Support equipment.
 - (3) Supply support.
 - (4) Transportation, packaging, and handling.
 - (5) Technical data.
 - (6) Facilities.
 - (7) Logistics support resource funds.
 - (8) Logistics support management information.
 - (9) Depot maintenance planning.
 - (10) Testing (testability, on-and-off line testing requirement).
 - (11) Computer resource integrated support plan (CRISP)
(see AFR 800-14).
- c. Training (aircrew, operator, and maintenance training)
(see AFR 50-8):**

- (1) Anticipated utilization rates.
- (2) Average sortie duration.
- * (3) Sortie rate and duration.
- (4) Trainer and simulator usage.
- (5) Initial and recurring training.
- (6) Training equipment required.
- (7) Trained personnel required.
- (8) OJT program.
- (9) ATC training support anticipated.
- (10) Training support data required (computer software, manuals, audio-visuals, etc.).
- d. Communications support.
- e. Intelligence (special communications, target and mission planning materials, etc.).
- 9. Safety considerations:
 - a. System
 - b. Industrial
 - c. Occupational

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